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**Decision Support System
for Coalition Operations:
Final Report**

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M. L. Quinn
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EXECUTIVE SUMMARY

This final report summarizes the activities and major accomplishments of the Decision Support System for Coalition Operations (DSSCO) project. It traces the development and evolution of major DSSCO concepts and products, describes DSSCO software toolset development, and discusses potential future directions and final products based on the toolset. The reader will understand the origins of the DSSCO project, the methods used to design and develop the DSSCO software toolset, and progress in applying the toolset to realistic planning scenarios.

OBJECTIVE

The primary purpose of the DSSCO project was to develop software tools to help Commander in Chief (CINC)-level crisis action planners in forming effective plans for coalition operations involving military and civilian organizations from different countries. In support of this goal, a software toolset was developed that consisted of three primary components: a Planning Tool, a Task Visualization Module (TVM), and a Resource Database. The first two components incorporate detailed task protocols to guide mission planning and execution, while the third component has socio-cultural information about coalition participants that can be used when assigning tasks. Together, these three tools can help planners develop more effective plans for conducting multi-national coalition operations.

CONCEPTUAL BACKGROUND

The U.S. military is increasingly involved in coalition operations with civilian and military organizations and personnel from different countries and cultural backgrounds. To be successful, these operations require extensive collaboration and coordination among all mission participants. Collaboration and coordination require detailed, accurate planning before the start of a mission and the ability to revise those plans in response to changing conditions after a mission has started.

Coalition mission planners must therefore understand not only the capabilities of each mission participant, but also the cultural and organizational factors that influence how effectively mission participants interact with each other. When combined with the complexities in any large-scale mission, cultural and organizational factors make the planning task even more intimidating. One major goal of the DSSCO software toolset was to supply planners with information they need to become aware of the state of the planning process and any potential culture- or organization-based differences among coalition participants.

Large amounts of information must be collected, analyzed, categorized, integrated, and applied when developing a mission plan. These information-processing activities need to maintain situation awareness of developing circumstances that could dictate changes to the developing plan. This combination of complex information-processing demands and the need for ongoing situation awareness motivated the DSSCO project.

MAJOR ACCOMPLISHMENTS

Identifying Demands of Coalition Mission Planning

Planning, coordinating, and executing coalition missions that involve participants from countries with different cultures and organizations requires the coordinated efforts of many individuals and

groups. One chief shortcoming of traditional coalition mission planning methods has been that geographically distributed planners had little or no immediate awareness of each others' actions. This shortcoming made it impossible to consider those actions when performing planning tasks. The DSSCO project identified problem areas and coalition "make or break" factors—areas where support is needed for a developing coalition. These "make-or-break" factors were developed into a reliable and systematic way to allow mission planners to collaborate during the planning process. Although the prototype DSSCO toolset was intended for use at a single workstation, the architecture of the prototype can be expanded to support multiple workstations and distributed collaborative environments.

COTS/GOTS Software

An important lesson learned from this project was that there were cost savings in using existing software whenever possible. As part of the DSSCO toolset development effort, commercial off-the-shelf (COTS) and government off-the-shelf (GOTS) software were extensively reviewed. This review identified software applications that could be adapted to meet the needs of the DSSCO toolset. This effort contrasted with customary software development projects in which all the software required for a new application is developed without first attempting to use software originally developed for other purposes. The success of the DSSCO project at integrating and adapting pre-existing software into the DSSCO toolset indicates a possible time- and cost-effective strategy for other projects.

Planning Tool

The Planning Tool is the core component of the DSSCO toolset. It uses a flow chart to enable mission planners to visualize the planning process and guide them through it. Planners can follow the progress of plan development and anticipate upcoming tasks by noting the status of the various objectives, steps, and planning products shown by the Planning Tool. The Planning Tool provides detailed task lists for common types of coalition operations (humanitarian assistance, disaster relief, civil violence/armed conflict, famine, consequence management, and displaced persons/refugees). To initiate a plan using the Planning Tool, a planner needs only to specify the mission type. Once the type of mission has been selected, the Planning Tool provides a suggested template of tasks and sub-tasks appropriate for that mission. The Planning Tool is composed of the following three levels:

- Level 1 provides a graphical overview of the status of the crisis action planning process for CINC-level staff. This level shows plan objectives organized by phases; shows triggers and products of each planning phase; and displays the status of objectives, triggers, and products.
- Level 2 presents a summary of steps that can be followed to achieve each objective in Level 1. The requirements for completing each step, along with its current status, are shown.
- Level 3 contains the workspace for each step listed in Level 2. This level describes each step, provides advice for completing steps, has space for entering data and user notes, and provides links to information that can help carry out the step.

Resource Database

The Resource Database contains information about coalition partners. This information includes cultural, organizational, political, military, geographic, demographic, economic, and historical data.

These data describe the characteristics, capabilities, and limitations of the military and civilian organizations that are participating in a coalition operation. Differences among coalition members in any area that could hinder the implementation and execution of a mission plan are highlighted. The Resource Database also provides recommendations for reducing the harmful influence of these differences.

Task Visualization Module (TVM)

Planners use TVM to schedule the tasks and subtasks suggested by the Planning Tool, to which TVM is closely linked. TVM, which uses Microsoft Project to supply its basic functionality, displays the hierarchical relationship among tasks and subtasks in a Gantt diagram. Planners can easily see task durations, start dates, and end dates. TVM shows the temporal dependencies among tasks so planners can identify and avoid scheduling conflicts between tasks.

RECOMMENDATIONS

Coalition mission planning and execution are inherently collaborative activities. Therefore, a fully implemental version of the toolset must enable collaboration among its users. The DSSCO architecture can be extended to support multiple workstations and collaborative planning. This extension should be pursued to promote collaboration among planners who are geographically separated or who work at different times of the day.

Using the toolset to train Operations Planning Team (OPT) members and other personnel who create and evaluate crisis action plans has been successfully piloted. A Tutorial module of the toolset allows training expansion. Its comprehensive representation of Computer-Assisted Planning (CAP) phases and activities makes the DSSCO toolset a promising teaching aid for experienced and novice crisis action planners.

Technologies should be investigated for their ability to support enhanced features and capabilities of the toolset, which could include additional data push, knowledge mapping, data mining, and intelligent search and retrieval.

To reach its greatest potential, the toolset must be integrated with other software applications used in mission planning such as Adaptive Course of Action (ACOA) and Computer-Aided Evaluation of System Architectures (CAESAR). The ability to independently evaluate alternative courses of action and the influence of different organizational configurations on mission success would be useful complements for the DSSCO toolset's capabilities.

Continued database maintenance and expansion would keep its information current and allow it to be applied to different mission-planning tasks.

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INTRODUCTION

This final report documents the major accomplishments of the Decision Support System for Coalition Operations (DSSCO) project. In Fiscal Year 1999, DSSCO, an Office of Naval Research (ONR) advanced technology research project, began developing decision support software tools for U.S. military planners. These tools provide mission-relevant information that improves the effectiveness of coalition operation plans involving culturally diverse military and civilian organizations.

Multi-national coalition operations involving military and civilian organizations require detailed and accurate plans. Human and material resources must be gathered, organized, deployed, and implemented to execute an effective coalition operation. Planning coalition operations is demanding, even when coalition participants share a common organizational and cultural background. When participants come from diverse cultures, planning becomes even more difficult. Meeting this challenge is important. When cultural and organizational differences are not considered, missions can become ineffective or fail, along with their adverse political, economic, and military consequences.

In past coalition operations, cultural differences among coalition participants have hampered developing the common understanding that achieves mission objectives. Important multi-national coalitions have been vulnerable to embarrassing misunderstandings, costly errors, and ineffective execution. DSSCO decision support software tools can help U.S. military personnel consider the organizational and cultural diversity of multi-national coalitions.

BACKGROUND

A coalition operation¹ has become the most common operation undertaken by the U.S. military, a trend that is predicted to continue. Coalition operations include various mission types, from war to disaster relief. Since the mid-1980s, operations other than war (OOTW) have been the major coalition operation. Coalition operations often have major implications for national security, national interests, conflict deterrence, and world peace. They may have a high profile worldwide due to a large media presence. Significant problems have been encountered during several recent coalition operations.

Besides the challenges in any large-scale military operation, multi-national coalition operations require that personnel and organizations from different cultures work together effectively. The complexity of any multi-national coalition operation is greater than that of a unilateral response. Effective command and control during coalition operations demand extensive interaction between the U.S. and the foreign militaries in the coalition. Because the U.S. military often takes the lead role in coalition operations, mission success depends on the ability of U.S. military personnel to understand how to plan and coordinate with their coalition partners to achieve unity of effort. Within any coalition, determining the end-state for the operation is difficult because the respective governments of the coalition partners rarely share a single operational objective. Unity of effort becomes a challenge, requiring complex negotiations to determine force mix and frequent re-planning to accommodate organizational differences. No comprehensive knowledge base for coalition forces lists and compares capabilities, assets, procedures, and protocols (all necessary components for an effective military operation) for capability, flexibility, and deployment alternatives. To obtain effective

¹ In this report, the term "coalition operation" includes coalitions and alliances.

command and control, coalition members should reach a common understanding of the situation so they can act effectively. A decision support system is needed that describes organizational and cultural differences, and provides a common representation of an operation's tasks, scheduling, and logistics.

Reviewing the coalition mission problems showed the need for such a decision support system. Organizing and coordinating culturally and organizationally diverse individuals and groups is perhaps the most problematic aspect of multi-national coalitions. The following two examples show the importance of mission planning. The first example describes some pitfalls that can arise from inadequate planning. The second example shows how important an effective plan is to mission success.

Implementation Force in Bosnia

In the 1995 Implementation Force (IFOR) deployment in Bosnia, the lack of a coherent, consensually approved mission plan was a crucial shortcoming. There were multiple non-corresponding doctrines covering combined issues. Poor communications between partners and ignorance of other organizations' activities was common. These problems occurred among military partners and military and organizations within the humanitarian assistance (HA) community. Overlying many of the inter-organizational interactions throughout the mission was a lack of understanding of cultures and languages (Wentz, 1999).

DSSCO tools solve many of these problems. One DSSCO resource, the *Coalition Planning Guide*, highlights important areas for operating procedure agreement. The Task Visualization Module (TVM) allows participants to share task plans and schedules. The Resource Database and its associated reports provide easy and timely access to cultural information during the planning process.

Operation Uphold Democracy in Haiti

Operation Uphold Democracy in Haiti has been called "a model of effective planning" (Davidson, Hayes, and Landon, 1996, p. 19). For the first time, the HA community was brought into the planning process early. The military has usually not included the HA community in the planning process. Contact for situation assessment has often been delayed past the arrival of the military in the theater of operations. Because these organizations possess vast knowledge and resources, they should be considered force multipliers for a coalition operation.

The DSSCO Planning Tool encourages planners to make early initial contact with HA and other non-military organizations, and to include them in planning and fact-finding. Information to ease communications—points of contact (POC), reports of capabilities, etc.—supports the development of an inclusive versus a unilateral planning process.

Critical Processes in Coalition Operations

The DSSCO project team studied the processes that U.S. military planners use to plan and execute coalition operations. They completed an extensive literature review encompassing doctrine, field manuals, lessons learned, academic analyses, workshop reports, and interviews with participants of recent coalition operations. Accounts of several coalition operations were analyzed within the U.S. military's planning and execution processes. Through participation in joint military exercises, the DSSCO project team saw active planning and execution processes. After analyzing the data, the

DSSCO project identified four group-level processes critical to coalition operations (Heacox, O'Mara, & Kelly, 1999).

Inter-Group Planning. The following components of inter-group planning provide many important functions for a coalition operation:

- Inclusion planning is the degree of inter-group involvement in the planning process. The involvement of operation participants during the planning phase initiates the building of trust and positive working relationships. Involved non-military organizations, such as humanitarian assistance organizations that will be in the operational theater, should be contacted and included as early in the planning phase as possible.
- A common and consistent goal is the degree of a common target and strategy (role compatibility) for mission accomplishment by all participants in theater. The early establishment of a common and consistent goal from multiple perspectives will set a solid foundation for unity of effort as the operation is executed.

Inter-Group Coordination. Effective inter-group coordination is important for successful execution. Inter-group coordination has the following two components:

- **Service Orientation.** In a service orientation, the goals of the mission, rather than separate agendas, drive day-to-day operational decisions. A service orientation encourages teamwork, high morale, trust, and goodwill by allowing groups to see that they are working toward a common goal.
- **Reciprocity.** Reciprocity exists when mission participants mutually help each other in mission tasks. Reciprocity is a force multiplier that leads to highly efficient personnel and material resource use.

During case study analysis and interviews with experts, the DSSCO project team identified several instances of adequate and inadequate coordination:

- **Adequate Inter-Group Coordination.** In operations in Iraq, Bangladesh, and Rwanda, U.S. military leaders promoted task reciprocity, which led to sound working relationships, cooperation among organizations, and shared commitment to the mission.
- **Inadequate Inter-Group Coordination.** In operations in Somalia, havoc resulted when food was air-dropped before notifying humanitarian assistance organizations of the drops. The lack of a “big picture” of mission operations and consequent poor inter-group coordination produced many operational inefficiencies and misunderstandings among coalition partners.

Inter-Group Communication. Coalition operations are often executed in dynamic situations where effective inter-group communication ensures a fluid and flexible response. Inter-group communication has the following two components:

- Inter-organizational communication includes information-sharing between leaders from different groups (e.g., participating militaries, United Nations, humanitarian assistance organizations). Inter-organizational communication keeps participants “in the loop,” creates ease and speed in finishing difficult tasks, improves planning/re-planning, and reduces major mistakes.
- Information transfer includes information flow from group leaders to those performing in the field. Effective information transfer enhances unity of effort by executing tasks efficiently.

During case study analysis and interviews with experts, the DSSCO team identified several instances of adequate and inadequate inter-group communication, including the following:

- **Adequate Inter-Group Communication.** In an operation in Iraq, the lead agency, the Office of Foreign Disaster Assistance (OFDA), encouraged initial contact and relationship building among military and humanitarian assistance personnel. Information exchange among these functionally divergent groups was simplified because personnel lived close to one another. Difficult tasks were finished easily and quickly.
- **Inadequate Inter-Group Communication.** In an operation in Somalia, the Civil-Military Operations Center (CMOC) was physically separate from the lead agency's humanitarian operations center and from the humanitarian assistance organizations' operation centers. This separation hindered joint problem solving. An "Us versus Them" mentality developed, fed by mutual distrust based on poor communication.

Inter-Group Training. As coalition operations bring together unfamiliar participants in unfamiliar lands, cultural awareness and experience can enhance inter-group training. Inter-group training is composed of the following two components:

- Cultural awareness is behavior by coalition participants that demonstrates awareness of and respect for the customs and values of the host nation and participating organizations. Cultural awareness can lead to goodwill, positive publicity, and effective operations.
- Joint rehearsal is specific combined training or simulation exercises before or during a mission that allow individuals and organizations to become accustomed to a unity of effort.

Facilitating Critical Processes During Coalition Operations

To promote inter-group planning, coordination, communication, and training during coalition operations, DSSCO created decision support tools for crisis action planning and execution monitoring by coalition partners. DSSCO builds on the web-based information technology systems architecture being developed for U.S. Pacific Command under existing programs. Analysis of past coalition operations and of procedures used by expert coalition planners shows that DSSCO promotes an understanding of priorities, roles, and planned actions. This understanding can be shared among distributed partners, each with different backgrounds, training, and procedures. This capacity raised several issues related to the four critical inter-group processes discussed in the last section:

- What are effective information management strategies for multi-group planning?
- How do cultural differences affect decision-making in a cross-cultural coalition?
- How can information integration schemes support cross-cultural, crisis action prediction and analysis?
- Can graphical visualizations support cross-cultural situation assessment and understanding?
- How can information be formatted and displayed for collective (group) understanding in a cross-cultural environment?

The following guidelines were adopted to confront these issues in the initial DSSCO design process.

1. **Explicit Representation of a Standardized Coalition Planning Process.** While every military and civilian organization has a standard process for crisis action planning, these processes differ substantially across organizations. An important drawback is that few are aware of others' processes. A common standard process was needed that could be shared with all coalition partners. The process chosen for DSSCO was outcome-based and focused on the steps necessary to produce coalition plan documents and orders.
2. **Task-Based Guidelines and References for Completing Steps in Planning Process.** Coalition planners often become involved intermittently and on an *ad hoc* basis. Therefore, they need specific guidance on how to perform their planning duties, who to consult for further information, what was done in the past under similar circumstances, when specific planning actions are required, etc. Although planning procedures are discussed in several general handbooks, DSSCO presents this information to planners as action-oriented steps and references specific tasks.
3. **Context-Sensitive Support for Highlighting and Obtaining Required Data.** Coalition planners must actively request relevant information, must re-enter data many times, and do not know if coalition planners in other locations are working redundantly on the same task. DSSCO can track the tasks planners are working on, push relevant data to them, remember core elements of the established plan, and share this information with geographically distributed planners.
4. **Visualization of Planning Process and Planned Tasks.** DSSCO represents the planning process and the plan itself to planners and their coalition partners through text-based documents and messages. DSSCO uses a graphic display to help partners visualize tasks, time sequencing, interdependencies, and individual task performers.
5. **Baseline Templates for Action Sequences Commonly Used in Coalition Operations.** Experienced planners typically use generic action sequences that were effective in prior operations as their basic cognitive building blocks for coalition operations. These action sequences, or templates, are a series of tasks and subtasks necessary to complete a function (e.g., distribute humanitarian assistance goods). The DSSCO Planning Tool provides templates for these task sequences based on the current Universal Joint Task List (UJTL). The Planning Tool, based on the planner's description of the mission type, suggests a subset of task blocks that may be appropriate for a planning situation. The planner can then evaluate and adapt these task blocks for the mission's specific operational needs and constraints.

DSSCO Structure

DSSCO supports an information-centric approach to mission planning and execution through a multi-component software toolset. When completed, the DSSCO toolset will be an interactive, interrelated web-based information system that supports crisis action planning and execution during coalition operations. Heacox (2000d) provides detailed information about the (CINC)-level planning

process and Smillie² describes the features of the DSSCO toolset, which is composed of the following three major tools:

- The Planning Tool considers function allocation, workload distribution, and cultural and organizational impacts, and incorporates modeling and simulation techniques for planning coalition operations. Planning process status is highlighted and templates are provided for performing the sequences of tasks and subtasks associated with a particular mission type.
- The Resource Database provides contact and cultural information and considers cultural factors in decision-making, how organizational structures influence planning and operations, and the importance of the mission task processes in decision support.
- TVM provides a shared/common representation and tailored views for all coalition participants. The major element of TVM is the interface that displays event-based tasking assignments, task schedules, and task interdependencies.

Related Efforts

The DSSCO project overlaps with aspects of two other projects, Adaptive Course of Action (ACOA) and Computer-Aided Evaluation of System Architectures (CAESAR). The ACOA project is developing a comprehensive suite of software tools to aid planners in developing situational awareness, planning missions, and executing plans. Information exchange between the ACOA and DSSCO databases would be beneficial to both projects, offering users the capabilities of both systems. The CAESAR project uses modeling and simulation techniques to predict the outcomes of alternative courses of action, given a set of starting conditions and projected actions. One primary aim is to provide initial COA analysis and assessments based on effects-based outcomes. Because DSSCO also involves the comparative evaluation of alternative COAs, the modeling capabilities of CAESAR could provide a more systematic and quantitative way for COA evaluation than is available in DSSCO. DSSCO could use the sensitivity analysis capability of CAESAR to help identify actions that increase the likelihood of achieving mission goals. Another feature of CAESAR, temporal analysis, could also be valuable for DSSCO as it compares the sequence and timing of mission tasks on projected outcomes, suggesting opportunities for implementing mission tasks. The DSSCO team investigated these possibilities by applying CAESAR II/COA to the hypothetical demonstration scenario in the DSSCO toolset.

The first step in implementing the CAESAR II/COA model was for subject matter experts to collaborate in developing the relationships between causes and effects of the various scenario events. These relationships were organized into an influence net model representing a major outcome in the demonstration scenario. The influence net was then implemented in the CAESAR II/COA module. Sensitivity analysis determined which actions could contribute substantially in achieving the desired outcome. Selected actions formed the basis for the construction of COAs, namely, time-phased sequences of these actions. An executable model was derived to simulate these COAs and their effects within the demonstration scenario. The model generated probability profiles (the probability of achieving the targeted effects as functions of time). These profiles allow the effect of time-coordinated actions of the coalition partners to be presented to the decision-makers as probability

² R. J. Smillie. 2000a. "Decision Support System for Coalition Operations." Memorandum. SSC San Diego, CA.

estimates for achieving specific desired effects. The model also allows the probability that a particular action will achieve the effect to be isolated to estimate how much influence a particular action will have on the outcome.

Evaluation of CAESAR II/COA using the DSSCO demonstration scenario provided an invaluable opportunity to test the theories, tools, and techniques used by CAESAR II/COA in an operationally realistic scenario. CAESAR II/COA supported COA development and evaluation in a coalition environment. Sensitivity analysis selected major actions. The executable model evaluated task sequencing and timing, providing for the visualization of the probability of desired and undesired effects over time for a given set of tasks selected by the DSSCO toolset. These probabilities provide insight into the time it will take for desired outcomes to occur and highlight potential negative influencing events on those outcomes. The performance of CAESAR II/COA in the DSSCO demonstration scenario confirmed that it could enhance assessment and decision-making for COA selection, especially in helping decision-makers visualize the influence of timed actions contemplated during COA formulation (Wagenhals et al., 2001).

OBJECTIVE

The DSSCO project identified information needs during coalition planning and built a software toolset that can help in the planning and management of multi-national coalition operations (Quinn, 2000a).

ACCOMPLISHMENTS

The DSSCO project identified many critical shortcomings in coalition mission planning and designed interventions to remedy those deficiencies. The basis of toolset development was the identification of operational challenges, specification of information requirements that meet those challenges, and the technologies to organize and manage that information. The three major DSSCO tools were designed based upon human factors guidelines for information presentation with extensive use of information push to ease information search and retrieval. The Planning Tool shows the current status of the planning process and offers advice on how to meet specific planning objectives. The Resource Database aids knowledge management for the coalition planners. The Planning Tool and the TVM portray the distributed cognition of the distributed planners to smooth the progress of the planning effort and improve its efficiency. The TVM and companion CAESAR II module provide planners with visualization, modeling, and a simulation capability to evaluate the plan as it develops.

A crucial imperative of the planning process is to consider the operational realities of coalition missions involving groups from different cultures and organizations (O'Mara et al., 2000a, 2000b; Smillie et al., 2000). The DSSCO project focused on how organizational structure and cultural factors influence task performance during coalition missions, and on developing decision support technologies to improve task performance. DSSCO supports the Pacific Command (PACOM) J30-Operations Planning Team (OPT) in creating integrated plans for coalition operations.

REPORT ORGANIZATION

This following sections document the accomplishments of the DSSCO project. It begins by describing the overall system architecture of the DSSCO toolset, along with its three major components: the Planning Tool, the Resource Database, and the TVM. The discussion of each

component includes its functional requirements in terms of mission objectives, design considerations that determined its structure and function, and a description of its software implementation. Next, a discussion of its different modes of operation shows uses for the toolset. A hypothetical scenario of a specific mission-planning situation is included. The next section reports the results of a toolset usability study and includes suggestions for improving its effectiveness. The final section makes recommendations for improving the content and interface design of the toolset.

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SYSTEM ARCHITECTURE

This section describes the system architecture of the DSSCO toolset. This architecture is based on a user-centered design approach. Its individual tools were based on the tasks to be performed, anticipated work settings and conditions, and available information technology resources (Quinn and Heacox, 2000b; Quinn, 2000f). The resulting tools support information presentation and manipulation, knowledge management, distributed cognition, and modeling and simulation. A thorough understanding of the cognitive processes used by experienced crisis action planners provided important information for the toolset design process.

USER-CENTERED DESIGN APPROACH

The DSSCO toolset provides information that coalition mission planners need to plan a mission. DSSCO researchers used a user-centered design approach during toolset development. The information needs and cognitive processes of coalition planners were the foundation for toolset design. The information needs of planners were first identified and then evaluated for the tasks planners perform during mission planning. Experts in coalition planning, who were consulted throughout the DSSCO project, emphasized that effective mission plans develop based on the needs of the crisis situation. When building a mission plan, expert planners bring together their knowledge of the situation and recall from experience the tasks that comprised previously successful missions and the pitfalls that made those missions risky. Planning a mission depends on planners recalling events relevant to a new situation. Two limitations can arise: (a) planners cannot recall all information that is relevant to a new planning situation, and (b) any given planner may not have experiences that are relevant to a new situation.

The DSSCO toolset helps planners overcome these two limitations. It functions as a surrogate expert planner and provides planners with guidance for choosing tasks relevant to a situation. The DSSCO team used the types of operations described in Joint Publication 3-07, *Joint Doctrine for Military Operations Other Than War*, to develop hierarchical task blocks that represent specific responses to situation needs. During the Situation Development phase, as planners are assessing and describing the situation for the CINC's Assessment, the toolset suggests appropriate task blocks. Planners can accept or reject any tasks and their subtasks. This feature helps planners in beginning development of the mission plan early in the planning cycle. As the planning process proceeds, the toolset provides more options for expert assistance. Planners can view resources needed and choose resource assignments. This resource availability feature efficiently uses resources and establishes a continuous trail of plan development.

DSSCO TOOLSET OBJECTIVES

The DSSCO toolset allows mission planners to create operational plans for coalition operations. The toolset establishes a decision support system that furnishes mission-critical information and a structure for applying that information to plan development. The final version of the toolset will be used collaboratively in real time with authorized partners.

Based on a function and task analysis of the OPT, the toolset provides increasingly sophisticated decision support to the OPT as the crisis planning process develops. By using collaborative technologies and an open architecture, it is envisioned that the DSSCO toolset could be accessed concurrently by multiple users (e.g., OPT, Vehicle Internal Communications [VIC], Combined Joint Task

Force [CJTF], and CMOC) for different purposes. The end-product of toolset development is an interactive information system composed of interrelated components that support crisis action planning and execution during coalition operations.

DSSCO MODULES

Three types of tools are supplied in the DSSCO toolset. Figure 1 shows each type and its constituent modules. The dotted area at the bottom of the figure shows that DSSCO interfaces to other collaboration and planning systems in PACOM and other planning facilities. The Campaign Database Server was not developed to serve as the mission database in DSSCO Build 3. Therefore, the figure shows a separate local storage for current mission data and a separate mission database that was added to the DSSCO toolset to allow it to support multiple missions in that Build.

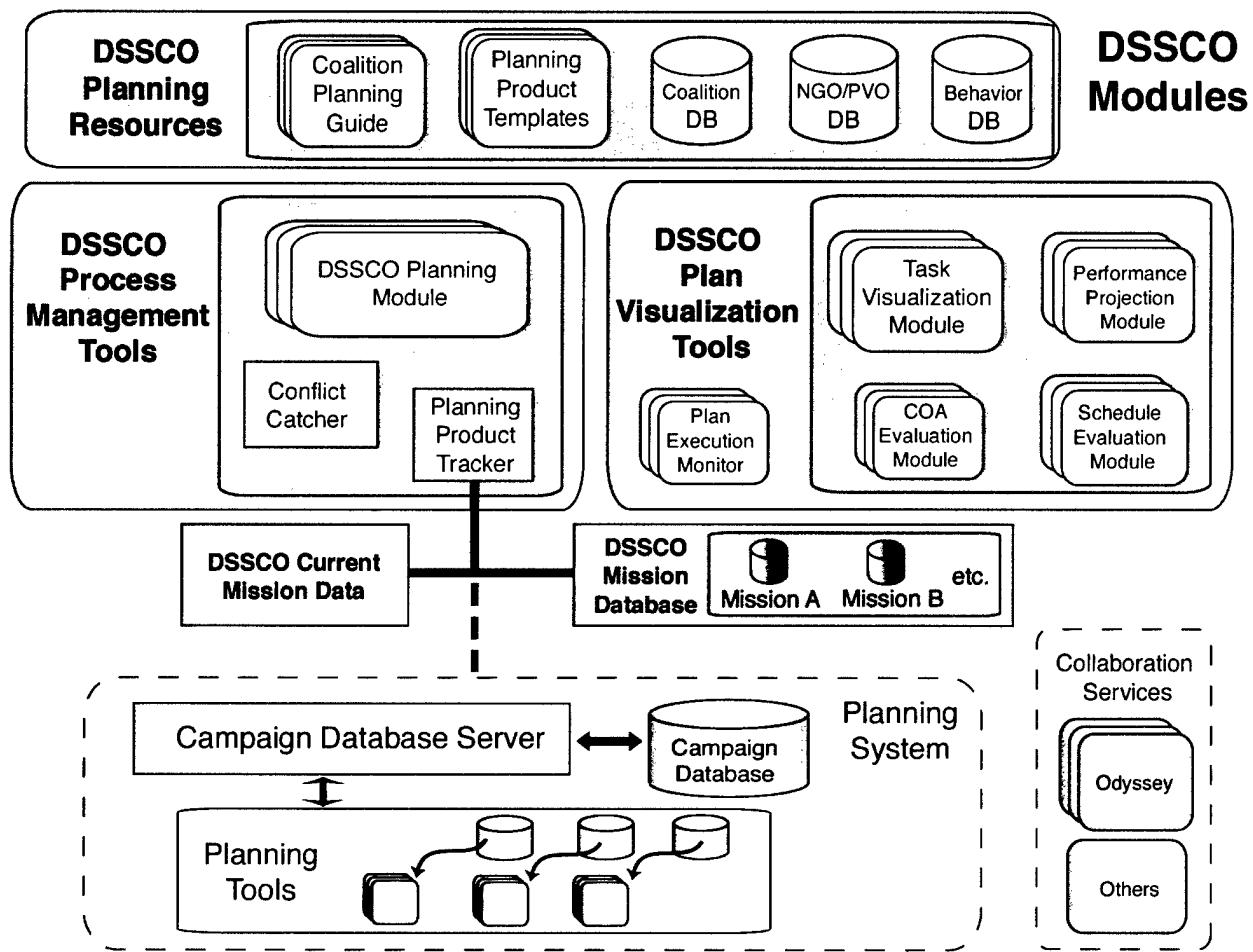


Figure 1. DSSCO toolsets and their constituent modules.

These tools support the information management requirements discussed in the section, “Critical Processes in Coalition Operations.” They support each of the four higher level information processing activities: information presentation, knowledge management, distributed cognition, and modeling

and simulation. Together, these tools support information management, planning, and simulation activities, and provide important decision support for coalition operations. The DSSCO Process Management Tools show the current status of the planning process and link the user to information needed in specific steps of the planning process (Heacox, 2000f). Figure 2 describes functions that each tool in the Process Management toolset is expected to perform.

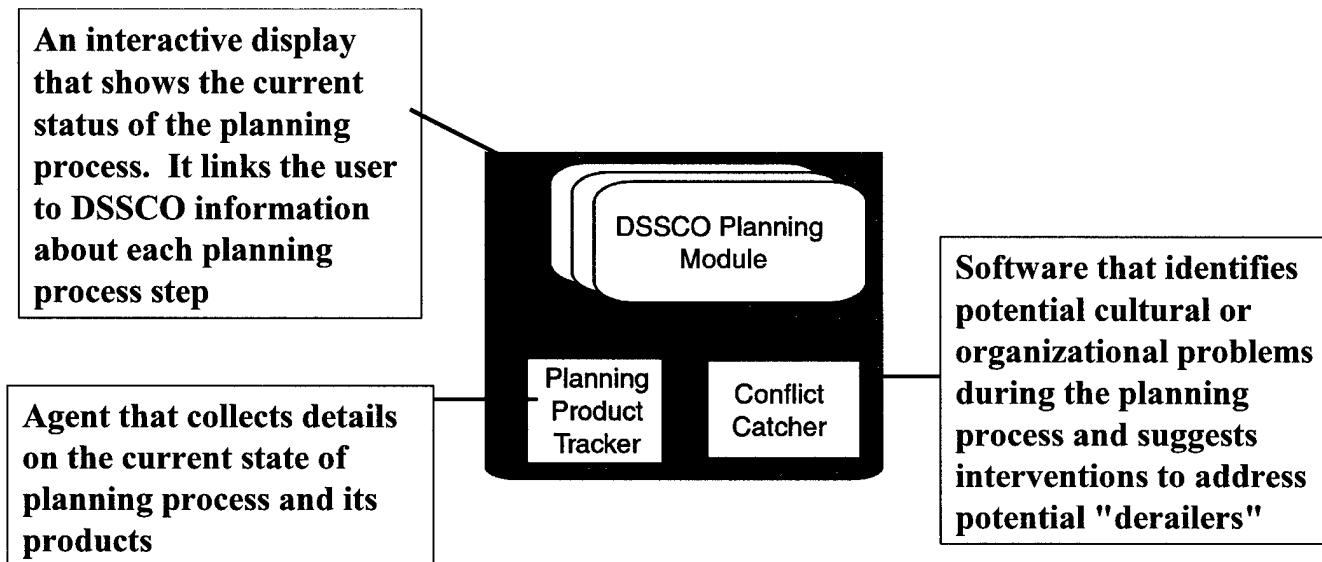


Figure 2. DSSCO Process Management Tools.

The DSSCO Process Management Tools show the current status of the planning process and link the user to information that can be used in specific steps of the planning process.

1. **Planning Module.** The DSSCO Planning Module shows the current status of the planning process and links the steps in that process to information used to create and visualize planning products. The Planning Module allows users without extensive experience in coalition planning to collaborate in building a mission plan. OPT planners view a standard overview of the entire process (Situation Development through Execution). This multi-user process map is based on the objectives that comprise the phases of the process. Distributed planners can view the status of these objectives and track the progress of the planning effort. Planning Tool users can drill down from these objectives to steps that meet each objective and workspaces that help complete the steps. Workspaces contain instructions about the type of data that should be gathered for each step, and link to information sources where that data may be collected or stored. Workspaces provide help on the purpose for gathering the data, instructions on how to complete standard planning products such as an Operations Order (OP ORD), and links to information on the capabilities and operational experience of specific coalition members.

2. **Conflict Catcher.** The Conflict Catcher identifies potential cultural or organizational problems during the planning process and alerts the Planning Module user to interventions that might reduce their effect on the planning products.
3. **Planning Product Tracker.** The Planning Product Tracker (PPT) is an agent that must operate independently of the other modules to identify changes to plans and to collect mission-relevant data that distributed planners create during the planning process.

DSSCO Planning Resources. The DSSCO Planning Resources store and organize information on the planning process, previous operations, and potential coalition members. These resources include templates for specific products of the planning process; information on the culture, history, and organizational structures of potential coalition partners; and the implications of any cultural or organizational differences for collaborative actions. Figure 3 describes the components of the Planning Resources.

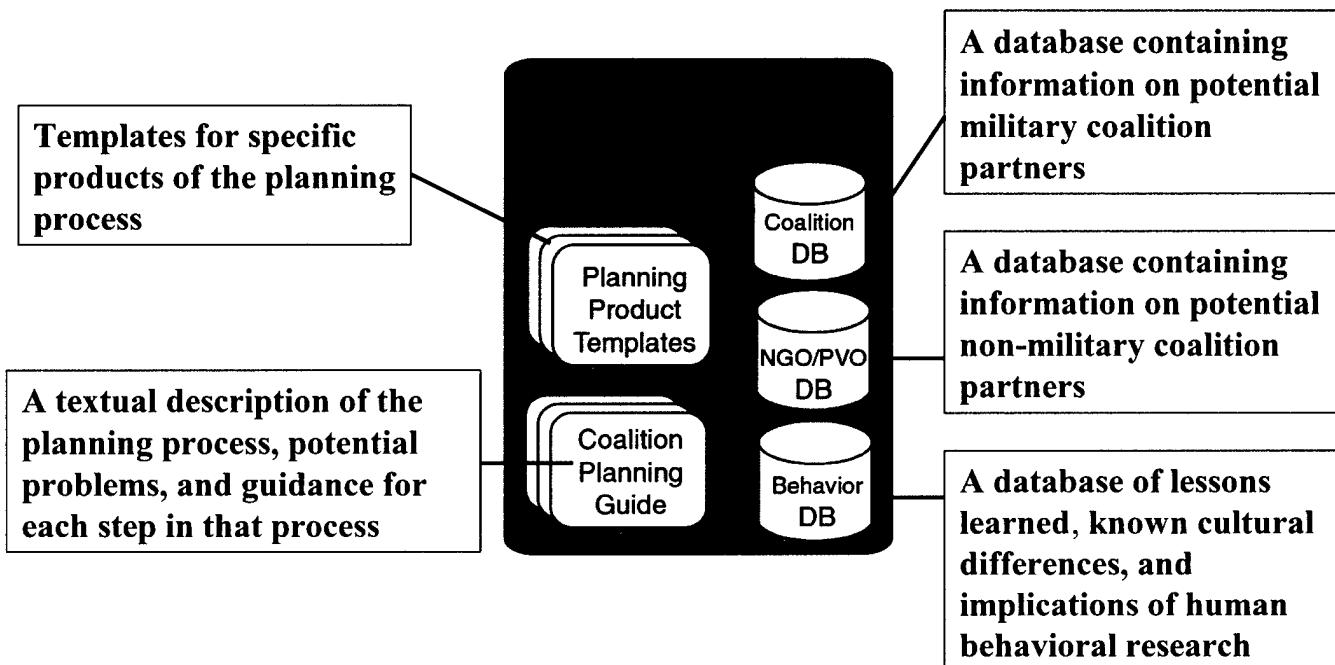


Figure 3. DSSCO Planning Resources.

1. **Planning Product Templates.** The Product Templates contain examples for each report generated during the planning process. Each template describes the fields that comprise the report and advice on the type of data that would be included in each report section.
2. **Coalition Planning Guide.** The Planning Guide has general advice on the crisis action planning process and specific advice for specific steps that can be followed to meet each planning objective.
3. **Coalition Database.** The Coalition Database has information about the history, culture, government, and experience of potential coalition members.

4. **NGO/PVO Database.** The Non-Governmental Organization (NGO)/Private Volunteer Organization (PVO) Database has information on the organizational structure, mission, and POC for potential non-military coalition partners.
5. **Behavior Database.** The Behavior Database has lessons learned, known cultural differences, and implications of human behavioral research for specific cultures and organizations.

DSSCO Plan Visualization Tools. The DSSCO Plan Visualization Tools provide a structured way to view a developing mission plan and to evaluate, schedule, and monitor the tasks and resources required for implementing the plan. Figure 4 shows the functions that the Plan Visualization Tools provide.

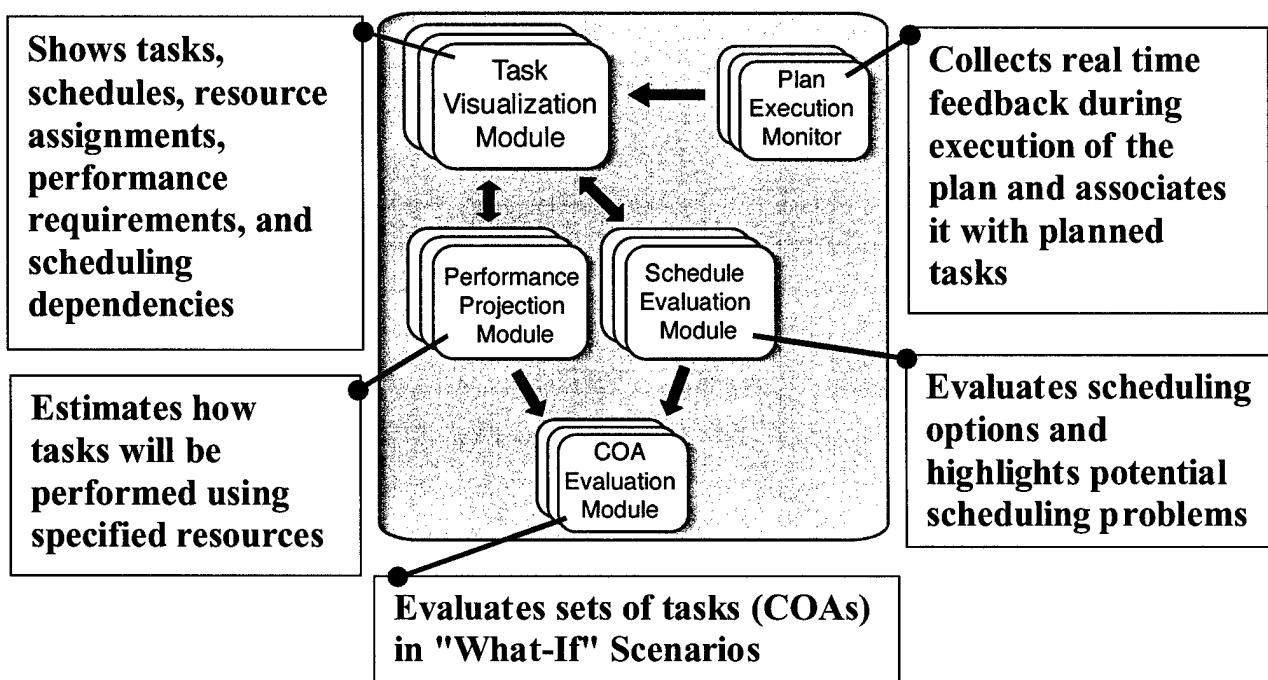


Figure 4. DSSCO Plan Visualization Tools.

The DSSCO Task Visualization Tools help planners visualize features of a plan that is being created, modified, or executed.

1. **TVM.** TVM displays (in a Gantt chart) the tasks of a mission plan that is being created, modified, or executed. Mission planners can manipulate the tasks and task durations (displayed as bars against the mission timeline) and the resources assigned to perform a task. Resource information for each task and task interdependencies are visible to help monitor and implement the plan. For distribution outside OPT, filters can be applied according to viewing privileges so that only specified parts of the mission plan are visible.
2. **Plan Execution Monitor.** The Plan Execution Monitor collects real-time feedback during execution of the plan and associates it with mission plan tasks.

3. **Schedule Evaluation Module.** The Schedule Evaluation Module gets the tasks, resources, and performance dependencies from the TVM and applies network analysis to identify potential scheduling problems.
4. **Performance Projection Module.** The Performance Projection Module estimates how specific coalition members, organizations, or adversaries will perform tasks. It uses information about the motivations and capabilities of potential collaborators and opposition forces to suggest how they can be expected to perform and how that performance might be helped or affected.
5. **COA Evaluation Module.** The COA Evaluation Module provides the planners with influence-net templates that capture the opinions of experts on factors that may influence COA outcomes. The module then uses simulation modeling (e.g., through CAESAR II) to evaluate alternative courses of action and suggest critical performance and scheduling dependencies.

INFORMATION FLOW

Each DSSCO module performs its functions in collaboration with other members of the DSSCO toolset and with tools provided in other Planning Tool suites. Since the DSSCO Planning Module provides a window into the planning process, the Process Management Tools provide an independent module, the Planning Process Tracker, to collect and store planning products and status information from any central databases that contain interim planning results. The DSSCO toolset can also be used alone to prepare planning documents or to teach the crisis action planning process. Figure 5 shows the information that flows between the DSSCO modules and each level of the DSSCO Planning Module during a planning session.

The dotted area at the top shows a general database that DSSCO interrogates for planning status and results. The Mission Data and DSSCO Mission Database provide this information for the current build of the DSSCO toolset since the content of the Campaign Database and the protocols required for the DSSCO Planning Process Tracker to access the Campaign Database have not been finalized.

BUILD 3 IMPLEMENTATION

Build 3 of the DSSCO project delivered a stand-alone prototype version of the DSSCO toolset that could be used to explain the crisis action planning process or to create and modify mission plans. This prototype toolset included three components built from the DSSCO modules described in the above architecture.

Figure 5 shows modules delivered in Build 3 with black borders. Modules with gray borders are parts of the DSSCO architecture partially developed in Build 3 or under independent development. Information flows to those modules are also grayed out to show that their information requirements may not yet be fully specified. Build 3 of the DSSCO Toolset delivered complete functioning versions of the DSSCO Planning Module, the DSSCO Task Visualization Module, and the DSSCO Planning Resources.

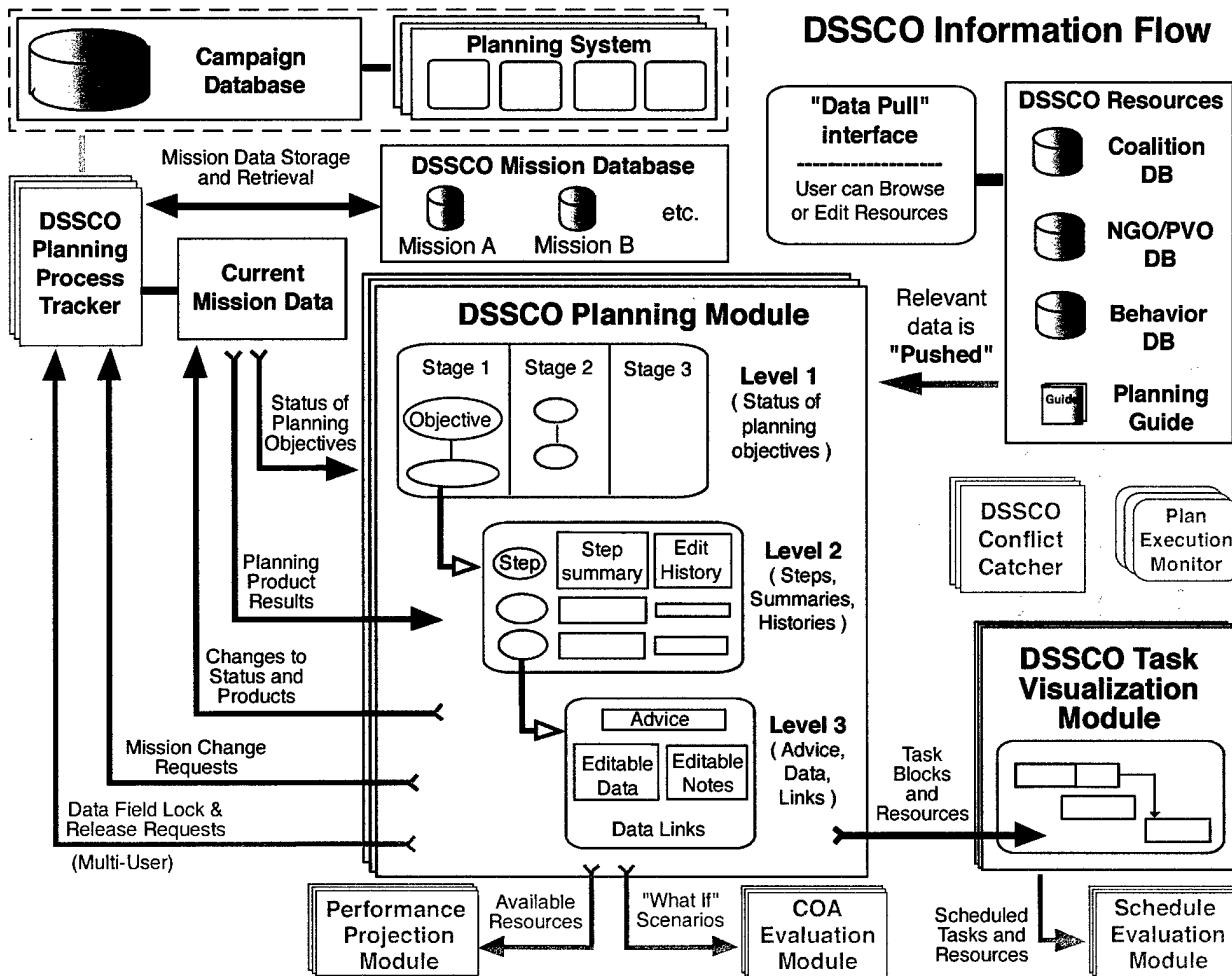


Figure 5. Information flow through DSSCO modules.

DSSCO Resource Database. The DSSCO Resource database includes demonstration versions of all the components of the DSSCO Planning Resources. The Coalition, NGO/PVO, and Cultural components of the Planning Resources can be browsed or modified through a user interface.

Demonstration Scenario. Data for a fictitious mission, “Helping Hands,” has been entered into the Resource Database. A scenario in which plans for this mission are being created and modified demonstrates the DSSCO Toolset.

DSSCO Planning Tool. The DSSCO Planning Tool is based on the Planning Module, but adds the linkages and mission data storage facilities (in black in figure 5) to produce a stand-alone application for creating, modifying, and monitoring the status of crisis action planning documents. The DSSCO Planning Product Tracker has been partially implemented in Build 3 of the Planning Tool to store and retrieve data from a local mission database. This feature allows the DSSCO Planning Module to support multiple missions without accessing the Campaign Object Database.

TVM. A complete working version of the TVM is in Build 3 along with linkages to the Planning Module that pass task and resource information between the two components. Several of the modules specified by the DSSCO architecture were not in Build 3 or were only developed far enough

to support the Demonstration Scenario. The interactive Demonstration Scenario provided with the build includes messages that come from the Conflict Catcher and Plan Execution Monitor modules to alert the planners to a few specific problems that arise during that scenario. Full functionality of these modules awaits further development. The DSSCO Planning Resources are only partially linked to the Planning Module in Build 3. All the databases are provided, but they are stand-alone modules in Build 3 rather than dynamically linked databases. Full implementation of the Resource linkages is planned for later builds that support multiple users through a database server architecture. Task templates were developed for the situations that occur in the Demonstration Scenario and for various other similar situations, but they do not cover the entire range of crisis action planning.

The Performance Projection Module (PPM), COA Evaluation Module (COAEM), and Schedule Evaluation Module (SEM) are under development as separate tools using a CAESAR engine for the PPM and COAEM and a petri-net analysis engine for the SEM. Prototypes of these modules operate independently without linkages to the information passing through the other DSSCO toolset modules.

LINKS TO ACOA

ACOA is a research and development project independent of DSSCO that is also creating software tools for crisis action planning. ACOA has developed many tools for helping planners in developing situation awareness, execution planning, and mission execution. Given the areas of overlap between these two projects, the question arises, "How can software from the two projects support each other to meet mission planning goals?" DSSCO is functionally independent of ACOA, but serves as a window into the Campaign Object Database, which is part of ACOA. DSSCO shows the status of the current plan and organizes entries to show planning progress and results. One reachable goal would be to have most DSSCO data fields automatically filled using data that ACOA has gathered, stored, and tagged. Data from DSSCO could then be added and reinserted into the same fields in the database for the ACOA campaign object. The potential value of this capability for ACOA and DSSCO indicates that ways to link them should be investigated and developed. Effort must be made to ensure interoperability between DSSCO tools and the ACOA campaign object and related applications.

DII COE COMPLIANCE

The Defense Information Systems Agency (DISA) developed DII COE to help Government agencies and their contractors develop software and databases. DoD will rely on DII COE to provide the degree of system integration and interoperability needed to meet diverse operational requirements. DII COE compatibility requirements should therefore be considered when developing new software. Appendix A discusses DII COE in more detail and the degree to which the DSSCO toolset meets its requirements.

DSSCO PROJECT DOCUMENTS RELEVANT TO THIS SECTION

Heacox, N. J. 2000f. "Identification of Links Between Planning Process Activities and Coalition and NGO/PVO Databases." Technical Note (May). Pacific Science & Engineering Group, Inc., San Diego, CA.

Quinn, M. L. 2000a. "DSSCO Concept of Operations." Technical Briefing (January). Pacific Science & Engineering Group, Inc., San Diego, CA.

Quinn, M. L. 2000f. "Updated DSSCO Architecture and Information Flow." Technical Note (August). Pacific Science & Engineering Group, Inc., San Diego, CA.

Quinn, M. L. 2000h. "Implementation Plan for DSSCO Tools." Technical Note (October). Pacific Science & Engineering Group, Inc., San Diego, CA.

Quinn, M. L. 2001. "DSSCO Architecture." Technical Briefing (January). Pacific Science & Engineering Group, Inc., San Diego, CA.

Quinn, M. L. and N. J. Heacox. 2000b. "DSSCO Architecture and Usage Concepts." Technical Briefing (May). Pacific Science & Engineering Group, Inc., San Diego, CA.

Quinn, M. L. and N. J. Heacox. 2000c. "DSSCO Software and DII COE Compliancy." Technical Note (October). Pacific Science & Engineering Group, Inc., San Diego, CA.

PLANNING TOOL

The Planning Tool is the “home base” of the DSSCO toolset. It has the major functions and features needed to create crisis action plans and provides links to the other two major components of the toolset, the Resource Database, and the TVM.

FUNCTIONAL REQUIREMENTS

The process of planning and executing an operation involving a multi-national coalition requires a high level of organization and coordination. Diverse military and non-military groups must be brought together in a common effort. The successful development and execution of a coalition mission requires not only that these diverse groups be assigned tasks they can perform, but also that they work cooperatively with other groups, some with different cultural backgrounds and organizational structures. The complexity of coalition operations requires that detailed plans describe specific tasks, that resources be assigned to each task, that communication and coordination among participants be enabled, and that the situation be monitored for changes that require modifications to the original plans.

To achieve these goals, the DSSCO team conducted a comprehensive survey to identify the functional requirements for the DSSCO toolset. They performed an extensive literature review to identify major areas of vulnerability for U.S. military participation in coalition operations. Publications reviewed included lessons learned, academic analysis, and workshop reports (e.g., Center for Army Lessons Learned, 1993; Easter, 1996; Hartley III, 1996; Seiple, 1996). Veterans of coalition operations were interviewed as experts; these experts included representatives of military and non-military organizations. Pertinent doctrine (e.g., The Joint Staff, 1995a) was reviewed for policies and procedures that establish U.S. military's involvement. The process for responding to a crisis situation was explored and assessed as the basic workflow design of the virtual organization (The Joint Staff, 1995b). Other agencies' response plans were studied (e.g., State of California, 1998; United Nations, 1995). Finally, accounts of several coalition operations were studied (e.g., Center for Army Lessons Learned, 1992; Hayes and Wheatley, 1996; and Wentz, 1997). The DSSCO team analyzed each operation for the U.S. military's execution process.

Macromedia Director™ was the development environment used for creating the Planning Tool. Macromedia Director™ was chosen because it supports file management, allows rapid graphical user interface (GUI) prototyping, supports procedural calls to databases and external programs, and uses an underlying procedural language that supports status logic.

Identification of Intervention Requirements

Initial intervention strategies focused on the execution process (i.e., after the virtual organization has created its response plan). Assistance was required to fulfill the following interrelated needs:

Need to Communicate Response Plan Status. A mechanism must allow coalition partners to be aware of the current status of activities. This awareness leads to an increased unity of effort. The intervention must reduce redundancies and facilitate commitment to the mission. As partners understand their own contribution and those of their partners, distrust should decline.

Need to Coordinate Force Resources. A mechanism is needed that allows participants' resources to be used optimally. The intended result is an increased level of efficiency, a force multiplier. The

intervention must allow participants to access information on the capabilities of coalition partners and to view the consequences of alternate task constraints and performance levels.

DESIGN CONSIDERATIONS

Based on the functional requirements described above, a Planning Tool was designed for collaborative, real-time use by coalition partners (Quinn, 2000b). The Planning Tool displays the building blocks of a mission plan as it is created. Because a plan involves objectives that are achieved by performing tasks with specified resources, the Planning Tool shows a plan as a set of tasks.

The Planning Tool enables all coalition partners to visualize the planning objectives and the steps that must be accomplished to meet those objectives. Its integrated display enables collaborative planning and "what-if" analyses to explore the implications of actual and planned event timeline issues. The boxes represent the objectives to be completed by various coalition partners. The connecting arrows allow decision-makers to visualize the planning dependencies, time sequencing, and resource-sharing requirements between objectives and organizations. Each objective box can also be decomposed hierarchically to reveal subordinate steps and links to status information. Steps are linked to databases that contain information about the assigned partners' resources, experience, policies, socio-cultural background, and POC. This information helps in the optimal assignment of partners to tasks. It also promotes rapid contact with partners if re-planning becomes necessary.

BUILD 3 IMPLEMENTATION

The Build 3 implementation of the DSSCO Planning Tool incorporates many recommendations for improvements based on military planners' evaluations of earlier versions of the Planning Tool. This section describes the major features of the Planning Tool and shows how planners can use them to create crisis action plans for various mission types. Planning Tool components are organized into Levels 1 through 3. Each level corresponds to a more detailed description of the activities required by the planning process. Figure 6 shows Level 1 of the Planning Tool, which is the starting point for planners as they begin to create crisis action plan. Level 1 shows the flow of information through the planning process:

- Information inputs initiate its phases (triggers).
- Planning products are generated at several points during Computer-Assisted Planning (CAP).
- The sequence of objectives must be fulfilled to complete each phase.
- Sources of information are needed to complete the planning products.

Figure 6 shows that these activities are organized into six phases: Situation Development, Crisis Assessment, COA Development, COA Selection, Execution Planning, and Execution.

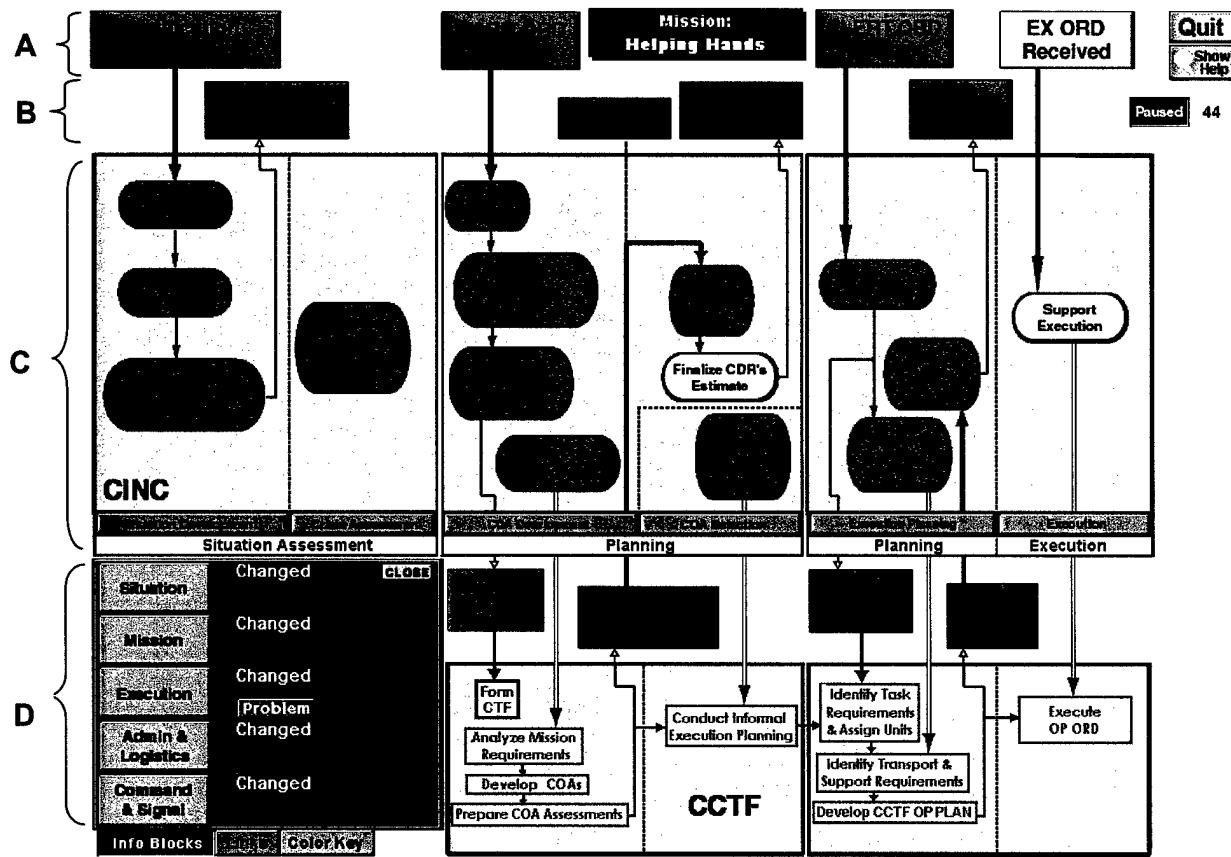


Figure 6. Level 1 Planning Tool components when tool is launched.

Triggers are events that initiate the next activities of the planning process for CINC-level planners. Triggers may be world events or standard message documents that National Command Authorities (NCA) sends to CINC-level planners during the planning process (see A in Figure 6; triggers are shown as boxes with arrows leading into the top of the process diagram; i.e., “Notification Received,” “WARN ORD,” “ALERT ORD,” and “EX ORD”).

As part of the planning process, several planning products are produced that CINC initiates or receives. Planning products are standard message documents that CINC-level planners produce and send to NCA (see B in Figure 6; planning products are shown as boxes with arrows leading out from the process map; i.e., “CINC ASSESS,” “CDR EST,” and “OP ORD”). NCA uses these documents in their situational assessment and in developing an appropriate response. The Planning Tool has templates for each document (O’Mara and Heacox, 2000). Content items of the templates are tied to the steps and substeps of the planning process. These links allow the workspaces in the Planning Tool to supply the planner with the information to complete each document.

Objectives are goals within the planning process that planners should accomplish as the situation progresses through its various phases (see C in Figure 6; objectives are the buttons within the process map; e.g., “Identify Problem,” “Analyze Situation,” etc.). Successful completion of the objectives for a planning phase generates a product that contributes to the crisis action plan.

Information blocks (see D in Figure 6) compile the latest information into topics. These topics are relevant to sections of the Planning Products. Planners can access these information blocks to see the latest entries in these topical areas rather than searching through the Planning Products or through the workspaces. Information displayed in the information blocks is redundant with information entered in the workspaces. Planners can edit information blocks and will use these blocks as centralized depositories for the latest mission information.

Level 2 of the Planning Tool, which is accessed by clicking on any Level 1 objective, gives more detailed guidance on how to achieve that objective. Level 2 decomposes a Level 1 planning objective into a series of steps. Each step can be completed to accomplish the objective. To illustrate, Figure 7 shows that the objective “Analyze the Situation” consists of five steps (E in Figure 7). Often, requirements to complete a step involve gathering information for a Planning Product. Level 2 also shows the work completed on each step (F in Figure 7) and notes that a plan may have been entered (G in Figure 7). A log of information additions to the step can also be displayed, identifying who entered information and at what date and time.

Analyze the Situation

Steps	Summary	Step History	Show Notes
-----Security Issues-----	U.S. citizens and foreign nationals in or near the rebel held territory are at risk of being caught up in the civil	Completed by ACOA on 4/23/2001 at 1140	
-----Enemy's Objectives-----	The Catholic Resistance Milita may have legitimate grievances with the ROI, but the negotiations are fragile and have a high chance	Completed by ACOA on 4/23/2001 at 1140	
-----Coalition Objectives-----	A PACOM OPT is planning Humanitarian Assistance to the sovereign government of Indonesia.	STARTED by ACOA on 4/23/2001 at 1140 Completed by ACOA on 4/23/2001 at 1141	
-----Keys to a Successful Coalition-----	U.S./coalition actions will be lifesaving in nature and reflect strict neutrality in any political	STARTED by ACOA on 4/23/2001 at 1140 Completed by ACOA on 4/23/2001 at 1141	
-----Constraints on the Operation-----	Limited transportation infrastructure will limit tactical mobility. Outdated maps and hydrographic	Completed by ACOA on 4/23/2001 at 1141	

E **F** **G**

Figure 7. Level 2 steps for Level 1 objective.

Complete information about any Level 2 step can be obtained by drilling down to Level 3 for that step. Figure 8 shows the Level 3 workspace for the step, “Identify Friendly Resources.” Level 3 workspaces help planners in identifying, locating, and entering information necessary to complete a step. The following features help the planner in this process:

- Display of the different topics in this workspace, selected by clicking on the desired button (see H in Figure 8). This example shows Coalition Objectives.
- General instruction for completing the step is displayed at every workspace (see I).
- A text box for User Notes is provided (see J).
- Online Help (see K) provides more detailed instructions and supporting information from the *Coalition Planning Guide*, a DSSCO document with guidance for planning and executing coalition operations (Heacox, 2000i; O'Mara, 2000a). Help is available at most workspaces.
- Links to other information sources (see L) give access to more detailed information in several areas, including compatibility data for countries participating in the coalition, information on friendly and enemy force contingent capabilities and experience, NGO/PVO availability, and maps.
- An information entry space is provided (see M). The entry space is either a list of response options or a text box.

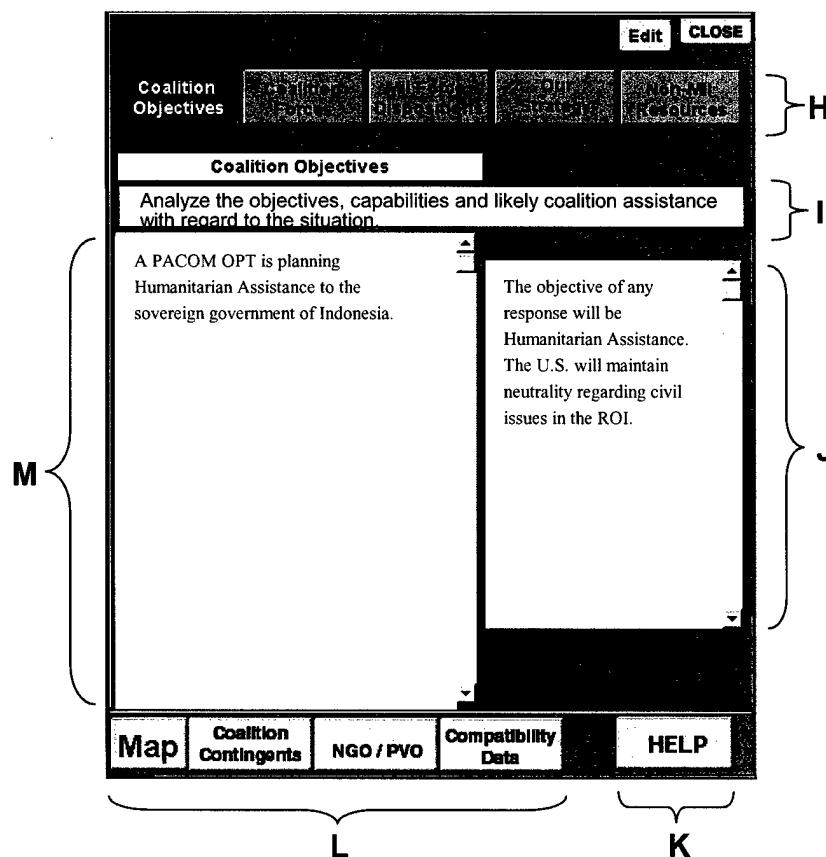


Figure 8. Level 3 workspace for step, "Identify Friendly Resources."

For some individual steps, Level 3 has direct links to other information resources that can help planners in completing those steps. Several types of resources are available (see buttons at L in Figure 8); this example shows country-level Compatibility Reports, organization-level Contingency Reports (available for coalition and enemy military contingents), and reports on NGOs/PVOs. These reports provide well-organized, pertinent information in one location. Most of the information for the reports is in the database. If information has not been collected, the (blank) report field suggests what information a planner should be looking for and a place to store that information when it is received. Many reports provide drill-down to more detailed information about the information categories.

Figure 9 shows a Level 3 workspace that includes the “Show Tasks” button (N in Figure 9). This button branches to the DSSCO TaskSelector. The TaskSelector module links the Planning Tool and the TVM. The TaskSelector uses the description of the situation triggering this mission to suggest blocks of tasks and subtasks appropriate for the situation described. It then allows the user to pick and choose which of the suggested tasks will be performed and suggests general resources and task dependencies that could accomplish those tasks. Planners can easily review, select, and deselect various theatre tasks based on the current Universal Joint Task List (UJTL) as they build the operational plan (Todd et al., 2000). Planners can select from this list when beginning to create a mission plan, then review and select or de-select tasks, if desired. The planner is provided with suggestions of task blocks that may be appropriate for the stated mission type. When the planners wish to schedule tasks, they can send the tasks to the TVM where they can be viewed and manipulated (by Microsoft Project) in a timeline or Gantt chart. The TaskSelector module does all the work needed to reform the tasks into a Microsoft Project document that is passed to the TVM for display and further modification.

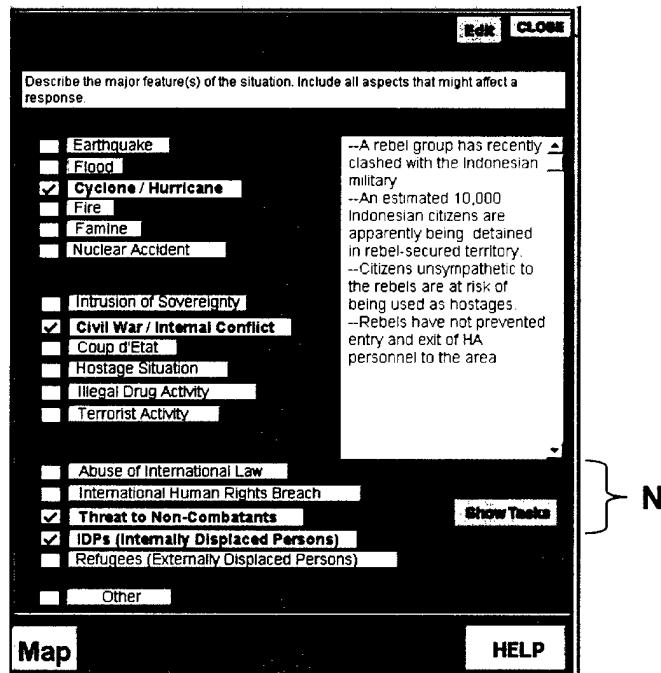


Figure 9. Level 3 workspace with “Show Tasks” button.

Figure 10 shows the TaskSelector module, which shows how some preliminary tasks and subtasks are related to each other for a given mission. Increasing indents from the left margin indicate the level of a task in the hierarchy. In this example, the task hierarchy consists of four levels of tasks and subtasks. The first level of the hierarchy consists of blocks of mission operations that are functionally categorized as follows:

- **Pre-Deployment:** Mission preparatory operations such as deployment of an assessment team and a Deployable Joint Task Force Augmentation Center.
- **Coordinate Operations Across Sectors:** Mission-wide coordination efforts such as deploying coalition forces to their assigned locations.
- **Sector Tasks:** Operations assigned for a specific geographic region; a mission may have only one sector or multiple sectors.
- **Disengagement and Handover of Efforts:** Mission-wide operations for transitioning out of the mission.
- **Redeployment:** Mission-wide operations about movement of forces out of the area to their next assignment.

TASK SELECTOR

Task:	Deploy Coalition Forces	Status:	<input checked="" type="checkbox"/> Pending	Begin	Done
Task		RESOURCE Needed	Assigned	Status	
<input checked="" type="checkbox"/> Deploy U.S. Forces	Subtask 1	AMC	US ALCE	Begin	
<input checked="" type="checkbox"/> Secure APODs	Subtask 2	AMC	US ALCE	Begin	
<input checked="" type="checkbox"/> Secure SPODs	Subtask 3	NAVFOR	US NAVCHAPG	Pending	
<input checked="" type="checkbox"/> Deploy Coalition Forces	Subtask 4	DOS,J-1,J-3	Country Teams	Pending	
<input checked="" type="checkbox"/> Coordinate Entry of Forces into Area	Subtask 5	DOS,J-1,J-3	Country Teams	Pending	
<input checked="" type="checkbox"/> Establish CMOC	Subtask 6	CAO,J-3	CTF J-3,US MAR	Pending	
<input checked="" type="checkbox"/> Establish Liaison with NGO/PVO/O and Coalition	Subtask 7	CMOC	CMOC	Pending	
<input checked="" type="checkbox"/> Determine & obtain agreement on coalition air	Subtask 8	CCTF,J-3	CCTF,CTF J-3	Pending	
<input checked="" type="checkbox"/> Ensure ROE understood and accepted by Coa	Subtask 9	J-3,JAG Staff	US J-3,US JAG	Pending	
<input checked="" type="checkbox"/> Coordinate US & Coalition forces transportati	Subtask 10	CMOC	CMOC	Pending	
<input checked="" type="checkbox"/> Obtain overflight and transit clearances	Subtask 11	Contingent,DOS	Contingent,US	Pending	
<input checked="" type="checkbox"/> Provide transport for media & equipment	Subtask 12	PAO	CTF Staff	Pending	

Resources Needed: J-3,J-4
 Resources Assigned: CTF J-3,CTF J-4

Figure 10. TaskSelector showing hierarchical relationships among tasks and subtasks.

Moving down the hierarchy from the first, second, third, and fourth levels shows successive levels of subtasks within the first-level categories. An arrowhead in the check box to the left of a task name indicates the task has subtasks. A branch line indicates the task has no subtasks. For example, in Figure 10, “Secure APODs” and “Secure SPODs” do not have subtasks, whereas “Deploy U.S. Forces” and “Deploy Coalition Forces” have subtasks.

For every task or subtask shown on the TaskSelector, the task bar provides the following information or functionality. A checkbox at the far left-end of the task bar precedes the name of the task or subtask. When the checkbox is selected, it indicates that the task is part of the mission plan. The task bar provides two other important pieces of information. The “Resources Needed” part of the task bar displays the type of resource needed to perform the task, typically, the type of unit that should be assigned. “Resources Assigned” lists the actual unit(s) assigned to perform the task, permitting planners to judge the degree of match between the resources needed to perform a task and those assigned. Finally, the “Status” Indicator shows the progress of work on a task, helping planners to determine whether a task has been completed, is in progress, or has been started.

Tasks can be edited in the TaskSelector and then sent to TVM, where they will be displayed as a Gantt chart. Planners can schedule tasks while considering potential scheduling conflicts with other tasks. The task editor (accessed by highlighting the task to be edited in the TaskSelector and then clicking on the “Edit Task” button) facilitates editing tasks, reviewing resources, and reviewing contact information. Figure 11 shows the task editor window for the task, “Provide Emergency Firefighting Capability.” In this example, task status and resources needed and assigned for the highlighted task are shown. The figure also shows contact information for these resources.

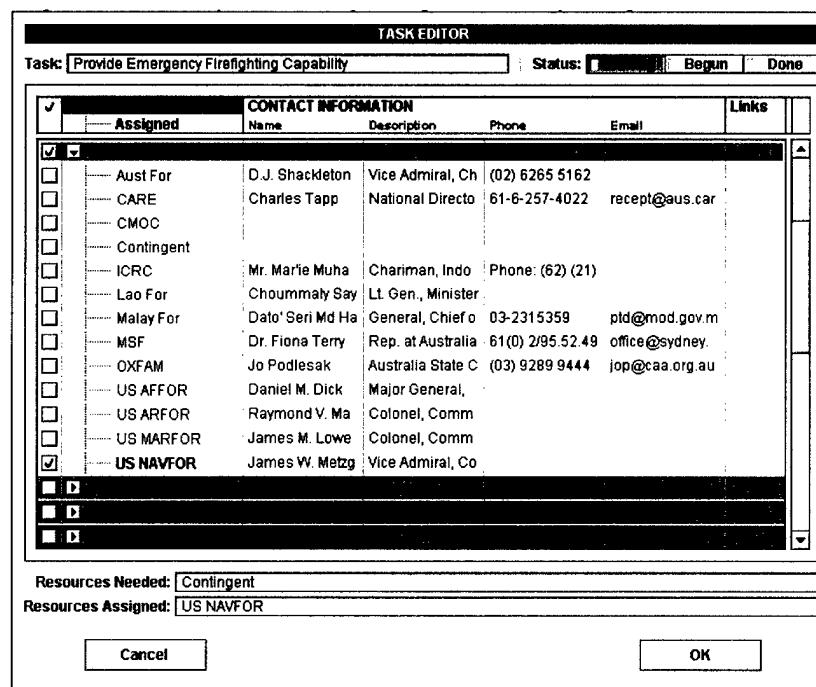


Figure 11. Task Editor showing resource and contact information.

ONLINE HELP AND TUTORIAL

CAP is a complex process involving many people and activities. To serve as an effective real-world planning tool, the DSSCO toolset incorporates this complexity in its structure and content. Online help makes CAP easier to understand and helps planners use different types of CAP information. An online tutorial provides more detailed instruction on using the DSSCO toolset in CAP. The major components of the online help and tutorial include the following:

Help-on-Help: Overviews the toolset's online help system, describes its content and organization, and provides hyperlink access to its components.

Content Help: Describes the information required or the actions taken to complete an objective or a step. Directs user to resources and information needed to complete planning tasks.

Planning Tool Features Help: Explains how a Planning Tool feature (phase, objective, step, etc.) is related to the CAP process; occurs at all three levels of the Planning Tool. Graphics often supplement text descriptions.

Rollover Help: Explains how to use specific features of the Planning Tool's interface to create a crisis action plan. A summary box appears when the cursor is held over an interface object supported with rollover help.

The Coalition Planning Guide: Defines a generic CAP process that is independent of any pre-established working relationship among coalition members. The Guide is accessible from most Level 3 help menus. The Guide is organized into six primary sections. Each section furnishes background information about a major area of coalition planning such as basics of coalition operations, command and control, crisis action sequence, success factors, and integration strategies.

The Guide also includes more detailed information tailored to the needs of specific activities, organized into 15 annexes. Topics include the six planning documents generated during CAP and many planning and management issues for combined operations.

Tutorial: Provides instructional modules with more detailed information about CAP and the DSSCO toolset than the online help components. The Tutorial is especially useful to novices in CAP or to inexperienced toolset users. Particular attention is given to the planning products that planners must generate to develop an executable crisis action plan. Tutorial components, which cover all aspects of CAP and the toolset, have a modular structure so users can selectively view only topics of interest. Tutorial modules also cover the toolset's more advanced features such as information blocks, resource links, the TaskSelector, and TVM.

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RESOURCE DATABASE

The Resource Database has information to support planners during crisis action planning of a coalition operation (Heacox, 2000a). It provides information on potential coalition members and guidance on planning, organizing, and executing mission plans that planners may need to develop effective mission plans. Resource Database information includes background information about (a) countries participating in a coalition operation, (b) host country and hostile groups (if any), (c) NGOs/PVOs that can provide assistance, and (d) specialized resources belonging to some coalition participants that can be available, if needed.

FUNCTIONAL REQUIREMENTS

Mission planners need an information source that helps them to find, access, and use information covering various topics to create and execute effective plans for coalition operations. This source must present and organize its information so the information can be accessed quickly and easily.

The Resource Database meets the demands of planning an operational mission composed of participants from diverse cultures. The cultural factors in coalition mission planning in the Resource Database are summarized below.

Culture: Its Definition and Importance to the U.S. Military

In a coalition operation, a host government, several militaries, and several NGOs interact. These groups represent diverse cultural and organizational types. This diversity increases the likelihood that problems will be encountered during coalition operations. A culture, whether societal or organizational, may be described by the values, behavioral norms, goal priorities, and ways of thinking shared by most of its members (Heacox, Gwynne, and Sander, 1998). These values are responsible for the differences in what is considered important and in the way people behave, or in how business is conducted. An understanding of the relationship between cultural values and behavioral consequences is essential to achieving inter-group cooperation and avoiding disjointed group efforts.

National Culture. A major theoretical viewpoint on culture contends that values form the core of cultures (Smith and Bond, 1993). Judgment of right and wrong, of good and bad, are part of the social learning passed down from generation to generation. Social norms and expectations for behavior are derived from values. In the cross-cultural values paradigm, cultures are described by comparative analysis of the values predominant in the cultures. Cultures are often profiled along many finite dimensions.

Hofstede (1980, 1983) produced the definitive work on cultures within the value paradigm by analyzing questionnaire responses from 117,000 IBM employees in more than 50 countries. Respondents provided information about their work experiences, including perceptions of their managers' styles of decision-making and value system. Through factor analysis, Hofstede identified four cultural value dimensions from country groupings. Later work by the Chinese Culture Connection (1987) added another dimension based on a study of Asian cultures, a region largely excluded from Hofstede's study. These five dimensions are as follows:

Power Distance (PD) is "the degree of inequality among people that the populace of a country considers as normal" (Harzing and Hofstede, 1996, p. 304).

Uncertainty Avoidance (UA) is “the degree to which people in a country prefer structured over unstructured situations. Structured situations are those in which there are clear rules how one should behave” (Harzing and Hofstede, 1996, p. 305).

Masculinity-Femininity (M-F) is “the degree to which values like assertiveness, performance, success, and competition, which in nearly all societies are associated with the role of men, prevail over values like the quality of life, maintaining warm personal relationships, service, care for the weak, and solidarity, which in nearly all societies are more associated with the role of women” (Harzing and Hofstede, 1996, p.304).

Individualism-Collectivism (I-C) is “whether one's identity is defined by personal choices and achievements or by the character of the collective groups to which one is more or less permanently attached” (Smith and Bond, 1993, p. 38).

Confucian Work Dynamism (CWD) is a bipolar dimension consisting of values "stressed in the teachings of Confucius" (Harzing and Hofstede, 1996, p. 317). The poles are long-term versus short-term orientation.

One important contribution of these five dimensions is that they allow testing specific hypotheses about cultural differences that influence inter-group effectiveness.

Organizational Culture. The five cultural value dimensions can be applied to organizations and societies. Erez (1994) defines the behavioral links with societal values as observed differences in organizations:

1. High PD is associated with high levels of hierarchy, paternalistic management, large status differences, and salary gaps between workers and management. Low PD is associated with a flat organization and small status and salary differences between workers and management.
2. High UA is associated with formal rules regarding rights and duties of workers and control of work processes, a larger number of specialists, and a norm of risk avoidance in decision-making. Low UA is associated with informal rules and procedures, more generalists, and individual decisions, even in risky situations.
3. High M (low F) is associated with management styles that stress independence, decisiveness, assertiveness, and adversarial negotiations. Low M (high F) is associated with management styles that stress group cohesion and group decisions, and with a problem-solving style of negotiations.
4. High I (low C) is associated with workers that act according to personal needs and interests. Low I (high C) is associated with workers that act according to interests of their ascribed groups.

Role of Cultural Factors

An understanding of the behavioral implications of the five Hofstede cultural factors can help military planners in meeting the challenges of working with diverse groups. For example, one issue commonly encountered when working with groups from another culture is determining who has the authority to make decisions. In some organizations, hierarchical differences are limited, and decision-making is decentralized. In others, hierarchies are tall, and decision-making is centralized. Another question planners must identify is the guidelines a group uses to make decisions and initiate

actions. In some organizations, uncertainty is met by the exercise of individual judgment. In others, structure is imposed through formalized procedures (e.g., rules of engagement [ROE]) in an attempt to control uncertainty.

The five cultural dimensions: PD, UA, M-F, I-C, and CWD convey important behavioral distinctions that can be used during the planning and execution of coalition operations. For instance, the U.S. military, in comparison to most NGOs, reflects higher PD, higher UA, higher I, and higher M. There is greater centralization of decision-making, a more defined hierarchy, more defined procedures, and more specialized roles. Militaries are more assertive than NGOs. These structural and operational differences are associated with differences that can become important as the organizations try to work together in coalition operations. For example, NGO personnel may have difficulty understanding *who* in the U.S. military chain of command has the authority to make a decision. Likewise, U.S. military personnel may have difficulty identifying a chain of command in an NGO and, therefore, be unable to contact important decision-makers.

DESIGN CONSIDERATIONS

Because several countries typically participate in coalition operations, planners need information about each participant country. This information can help decide each country's responsibility in an operation. The Resource Database has country-specific information that mission planners typically need, such as manpower, equipment, material, and logistical capabilities. The Resource Database has extensive information about each country's cultural background and traditions. This cultural information, which includes topics as diverse as cultural values, spiritual beliefs, and customs of daily living, is not usually found in the information resources of mission planners. When coalition participants do not recognize that cultural differences influence how participants interact, coalition operations are ineffective. This problem motivated the development of the DSSCO project.

BUILD 3 IMPLEMENTATION

The Resource Database in Build 3 of the toolset can be populated or viewed directly or accessed through the Planning Tool. The Resource Database is the source of information for Contingent and NGO/PVO Capability reports and Country Compatibility reports, which are accessible at relevant workspaces of the Planning Tool. In Build 3, these reports are static; however, with further development, they could be dynamically linked to the Resource Database.

- **Countries.** Each coalition country is described in several informational areas: geography and communications, history, diplomacy and trade, cultural data, government, and military (Heacox, 2000b). Figure 12 shows a country entry using Australia as the example. The sources of this information and the dates of data collection and source revision are provided for each area. The following information is contained in the indicated field:
 - **Geography and Communications:** Country description, capital city, bordering countries, bordering waters, undersea cables, and satellite earth stations.
 - **History:** Colonization, occupation, and historical events.
 - **Diplomacy and Trade:** Diplomatic relations, international disputes, treaties with the U.S., diplomatic contacts with U.S., trade relations, and membership in international organizations.
 - **People:** Population, ethnicity, language(s), religion(s), and quality of life.

- **Cultural Data:** Multiple screens present suggestions for working with people from this country, societal issues regarding this country, country profiles based on values dimensions (single country and comparison of two countries), and compatibility with U.S (Heacox and Quinn, 2000).
- **Government:** Government type, government structure diagram, chief of state, head of government, political party in power, and other political parties.
- **Military:** Military organization, military resources, military experience (Heacox, 2000j), and military structure diagram.

Country Name Australia

Geography

Country Description

Area: 7.7 million sq. km. (3 million sq. mi.), about the size of the 48 continental United States.

Cities: (1998) Capital—Canberra (pop. 310,100). Other cities—Sydney (4.0 million), Melbourne (3.5 million), Brisbane (1.5 million), Perth (1.3 million).

Terrain: Varied, but generally low-lying.

Climate: Relatively dry, ranging from temperate in the south to tropical in the north.

Data Modified 00/00/00

Data Source General Country Links
[SI Dept (bgnd notes)]
http://www.state.gov/www/background_notes/australia_899_bgnd.html

Source Updated 00/00/00

Bordering Countries

Capitol City: Canberra

Bordering Countries: None w/ direct land connection. Indonesia and Papua New Guinea are located to N separated by Timor and Coral Sea.

Bordering Waters: Indian Ocean to N, W, S; South Pacific Ocean to E

Bordering Countries 00/00/00

Bordering Waters 00/00/00

Communications

Under Sea Cables

Submarine cables to New Zealand, Papua New Guinea, and Indonesia

Under Sea Cables 00/00/00

Satellite Earth Stations

10 Intelsat (4 Indian Ocean and 6 Pacific Ocean)
2 Inmarsat (Indian and Pacific Ocean Regions)

Under Sea Cables 00/00/00

Satellites 00/00/00

Figure 12. Country entry in Resource Database.

- **NGOs/PVOs.** Non-governmental organizations are described, along with their areas of expertise and affiliations (Heacox, 2000e). Links to the sources of this information and the dates of data collection and source revision are also provided. Figure 13 shows a sample entry for one organization: Doctors Without Borders.
- **Description:** Organization category, number of employees, organization description, headquarters location, branch offices, Chief Executive Officer, headquarters POC, Liaison POC, other POC, and priorities.
- **Expertise:** Expertise categories, experience, resources, status with interaction, communications capability, and other capabilities.

- **Affiliations:** Religious affiliation, UN Economic and Social Council (ECOSOC) identification status and activity areas, and U.S. Agency for International Development (USAID) identification status and activities.

Doctors without Borders

2 of 6 Organization Name Domains Expertise Affiliations Modify Record Done

Description		Data Source	Data Collected	Source Updated	
Category	NGO	Number of Employees	http://www.msf.org http://www.doctorswithoutborders.org/intro.htm		
Organization Description		<p>Medicins Sans Frontieres (Doctors without Borders) is an independent humanitarian medical aid agency committed to two objectives: providing medical aid wherever it is needed, regardless of race, religion, politics or sex and raising awareness of the plight of the people they help.</p>			
Headquarters Location	39 rue de la Tourelle Brussels, 1040, Belgium				
Branch Offices	Australia, Austria, Belgium, Canada, Denmark, France, Germany, Greece, Hong Kong				
CEO					
HO POC	Mr. Jean-Marie Kindermans, President 39, rue de la Tourelle, BRUXELLES, 1040, Belgium Ph: (32-2) 280 18 81 Fax: (32-2) 280 01 73				
Liaison POC	Mr. Robert Muller (UN Office-Geneva) Ph: (41-22) 849 84 00 Fax: (41-22) 849 84 04				
Other POCs	Dr. Fiona Terry (rep. at Australia office) MSF-Australia, Suite C, Level 1263 Broadway, Glebe NSW 2037, Australia Telephone: 61(0)				
Priorities	<input type="checkbox"/> Protection <input checked="" type="checkbox"/> Acute Aid <input type="checkbox"/> Long Term Assistance Locations of Regional Offices Australia, Austria, Belgium, Canada, Denmark, France, Germany, Greece, Hong Kong, Italy, Japan, Luxembourg, The Netherlands, Norway, Sweden, Switzerland, United Kingdom, United States				
Data Source Data Collected Source Updated					
POC Links Branches CEO POC HQ POC Liaison Other POCs					
Priorities (MSF history website) http://www.msf.org/intweb99/library/history.htm					

Figure 13. NGO/PVO entry in Resource Database.

- **Country Contingents.** The Country Contingents section of the Resource Database has descriptive information about a contingent, its personnel, and its capabilities. Two categories of contingents are included: friendly contingents provided by coalition members and contingents hostile to the coalition. For each contingent, some or all of the following information is supplied, as appropriate for the contingent type: country name, organization name, headquarters POC, liaison POC, unit type, unit size, date available, priorities, equipment, prior experience, liaison ability, language, communications, transport, messing, medical, engineering (mines). Figure 14 shows a Country Contingent screen for one of the fictional contingents in the demonstration scenario.

Figure 14. Country Contingent entry in Resource Database.

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TASK VISUALIZATION MODULE

The Task Visualization Module (TVM) of the DSSCO toolset schedules, assigns, and monitors tasks that must be accomplished to carry out an operational mission plan (Quinn, 2000c). In its final form, it will support the highly collaborative nature of the coalition planning process. Task hierarchies and interdependencies can be displayed. Filters can be applied so that only selected categories of tasks are visible. TVM is linked to the Planning Tool. After tasks are selected using the TaskSelector in the Planning Tool, they are sent to the TVM for visualization of the scheduling and resource assignments.

FUNCTIONAL REQUIREMENTS

Many tasks and subtasks must be performed during a coalition operation. Planners must organize task scheduling, detect and resolve temporal conflicts among tasks, and avoid staffing and equipment incompatibilities. TVM enables the DSSCO toolset to achieve these goals. Upon receiving the tasks selected for a given operation from the Planning Tool, TVM displays them along a chronological timeline in a Gantt chart. This display is the schedule for performing the tasks that comprise the mission plan. The chart displays task duration (including start and end dates) and temporal dependencies among tasks. By noting potential conflicts, planners can develop plans that consider the need to perform some tasks before or concurrently with other tasks. TVM satisfies many functional requirements (Quinn and Heacox, 2000a), including the following:

- Chronological sequencing display format
- Tasks represented as boxes whose width shows the time window in which each task must be performed
- Visual representation of task dependencies based on scheduling, timing (e.g., politically determined start date), resource, or information requirements
- Visual representation of task performance details such as identification of the task performer
- Visual representation of subtasks (drill-down)
- Ability to display filtered views of the plan (e.g., tasks assigned to only one performer)
- Ability to display critical factors, milestones, and measures of effectiveness
- Ability to link to other modules or software components—such as (a) the Plan Execution Monitor, and (b) information sources such as the Campaign Object in the ACOA toolset—to pull and display information (e.g., task templates, alerts of resource inadequacies)
- Ability to be shared among geographically distributed users
- Ability to alert users to changes in the plan

DESIGN CONSIDERATIONS

A preliminary survey determined that the functionality of Microsoft Project is sufficiently compatible with the desired features of TVM to prototype this capacity. Its Gantt chart format is especially suited to portraying the relationships among tasks and subtasks, including task dependencies and task start and finish times.

Task Blocks

Following the philosophy of facilitating early and seamless continuity between planning activities and the development of the plan for forces in the field (Heacox, Moore, and Smillie, 2000), the DSSCO project has developed a set of task blocks. These task blocks show suggested tasks and subtasks for common mission activities and are triggered by the type of situation that underlies a mission. They can be selected or tailored to allow planners to visualize the plan as it develops from gross level tasks to detailed subtasks. TVM supports military (e.g., providing security for an area of conflict) and non-military (e.g., supporting a humanitarian assistance operation) tasks. Task blocks include the type of resource needed to perform each task in military and non-military organizations. The source of the task blocks used in TVM was doctrine and standard operating procedures. Additions and other modifications will continue to be made to this set of task blocks as the DSSCO toolset develops. Major task blocks include the following:

- **Situation Assessment and Preparation Tasks:** activities needed to provide information and in-country contacts for a mission.
- **Coordinate Operations across Sectors Tasks:** activities needed to administer a mission.
- **Sector Tasks:** activities that are geographically bound. There may be multiple sectors or only one sector in a mission. Displaying tasks in this manner allows the mission planners to visualize the unique needs of a geographic area and make assignments to meet these needs. The tasks in this block are the most situation-dependent and specific to a particular mission. The sector task blocks provide the following:
 - Operational Force Protection
 - Civil Search and Rescue
 - Emergency Medical Treatment
 - Emergency Firefighting Capability
 - Acquisition and Warehousing of HA Goods
 - Displaced Civilian Services
 - Refugee Administration
 - Civil Engineering Support for Food Production
 - Community Relations

- Civil Engineering Infrastructure Support
- Assistance to Local Authorities
- Extended Medical Assistance
- Extended Veterinary Services
- Mortuary Services
- **Disengagement and Handover of Efforts Tasks:** activities to prepare for transitioning the military out of a mission.
- **Redeployment Tasks:** activities to affect the transition of the military out of a mission.

BUILD 3 IMPLEMENTATION

After evaluating several commercial off-the-shelf (COTS) and government off-the-shelf (GOTS) applications related to the functional requirements of TVM, Microsoft Project was selected as the engine for TVM. Microsoft Project made implementation of basic TVM functional requirements timely and cost-effective.

TVM displays the same hierarchical organization of tasks and subtasks as the Planning Tool. As Figure 15 shows, like the Planning Tool, TVM also describes the resources needed and assigned to each task. TVM expands this representational capacity to include scheduling and dependency information. Planners can read task durations directly from the TVM Gantt chart. Alternatively, a cursor rollover of a task bar displays a task summary box that shows its name, start date, end date, and duration. Arrows linking tasks indicate task dependencies. Filters can display selected level(s) of subtasks or show only tasks that satisfy specified criteria such as tasks assigned to particular coalition participants.

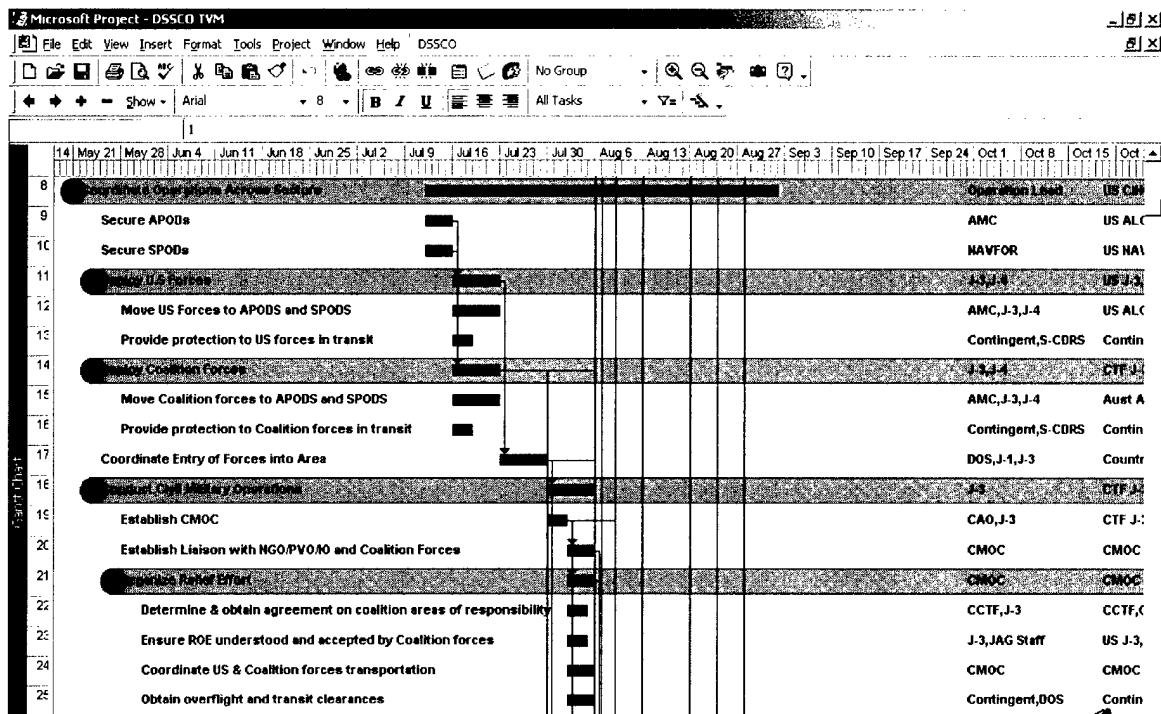


Figure 15. Task hierarchies, schedules, and interdependencies in TVM.

Task information can be edited in TVM by using a task information box that displays the task name, duration, start and end dates, resources needed, resources assigned, and contact information for assigned resources. Task duration, start date, and end date can also be changed, if desired. Figure 16 shows a task information box for the task, "Coordinate Entry of Forces into Area."

Assign Resources

Task Name: Coordinate Entry of Forces into Area

EdR Resource Assignments

Resources Needed:	Resources Assigned:	Contact Information:
<input type="checkbox"/> AMC	<input checked="" type="checkbox"/> Country Teams	Resource: Country Teams
<input type="checkbox"/> ARFOR	<input checked="" type="checkbox"/> CTF J-1	Name: J. Stapleton Roy
<input type="checkbox"/> BLT	<input checked="" type="checkbox"/> CTF J-3	
<input type="checkbox"/> CAO	<input type="checkbox"/> US DOS	Description: U.S. ambassador to Indonesia
<input type="checkbox"/> CB	<input type="checkbox"/> US J-1	Phone: [62] (21) 344-2211, Fax: [62] (21) 386-2259
<input type="checkbox"/> CCTF	<input type="checkbox"/> US J-3	Email: (not available)
<input type="checkbox"/> CINC		Links: (not available)
<input type="checkbox"/> CMOC		
<input type="checkbox"/> Contingent		
<input type="checkbox"/> CTF Staff		
<input type="checkbox"/> DDTFAC		
<input checked="" type="checkbox"/> DOS		
<input type="checkbox"/> EPMU		
<input type="checkbox"/> Inf Bn		
<input checked="" type="checkbox"/> J-1		
<input type="checkbox"/> J-2		

Resources Needed: DOS, J-1, J-3

Resources Assigned: Country Teams, CTF J-1, CTF J-3

Buttons: Cancel, OK

Figure 16. Task Information Box.

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USAGE SCENARIO

Mission planners use the DSSCO toolset to create and execute coalition operations involving military and non-military organizations and personnel from different cultures. The toolset facilitates mission planning by bringing together information relevant to particular types of missions and information needed to tailor mission plans to the specific political, cultural, and military characteristics of mission participants. The toolset has two principal modes of operation: "Interactive Demonstration" and "Plan a Mission." The interactive demonstration uses a pre-planned mission and pre-stored database information to illustrate the many features of the toolset and to train novice toolset users. Because the demonstration is closely modeled on CAP doctrine, it is scenario-driven to cover the major phases and events that occur during CAP. The mission-planning mode has no underlying scenario and allows a user to freely enter and retrieve plans for missions in response to externally developing situations. Retrieved plans can also be modified in the planning mode to meet the demands of a new mission when that new mission shares some characteristics with a previously planned mission.

An online tutorial provides toolset training. One part of the tutorial shows how to create a mission plan. Another part describes the CAP process in six phases and the hierarchical structure of objectives and steps within each phase. The tutorial emphasizes the parallel structures of the CAP process and the Planning Tool.

INTERACTIVE DEMONSTRATION

The interactive demonstration allows a user to explore the features of the DSSCO toolset as it is used to plan a realistic scenario showing a humanitarian assistance operation to eastern Java, Indonesia. In this scenario, the U.S.-led multi-national coalition involves Australia, Malaysia, Laos, and the U.S. The coalition's mission objective is to establish the facilities and means to distribute food, water, clothing, health care, and other needed supplies and services to non-combatant civilians in rebel-held eastern Java (Heacox, O'Mara, and Quinn, 2000; Heacox, Quinn, and Smillie, 2000; Heacox, 2000c, 2000g, and 2000h; Heacox, 1999). The capabilities of the DSSCO toolset are highlighted during this demonstration scenario, which uses all three primary components of the toolset (Planning Tool, Resource Database, and TVM). If the user does not interact, only the first level of the DSSCO Planning Tool appears. This level acts as a window into the planning process and shows the successive completion of each planning objective, culminating in an execution order to implement the plan. Users can interact by drilling down to show or modify all the DSSCO workspaces and information sources during development of the plan. All six planning products are completed during the scenario so that the user, by inspecting the finished reports, can understand their information requirements. The user can pause the scenario at specified times to examine the status of the overall planning process and its individual objectives and task steps.

MISSION PLANNING

The DSSCO toolset also generates new mission plans. The "Plan a Mission" mode allows users to enter data about a hypothetical or actual crisis situation and save it to a new mission file. This file can then be retrieved later to view or modify its contents as more information becomes available about a developing crisis. The "Plan a Mission" mode uses the full capabilities of the Planning Tool and its associated databases and task scheduling module. This mode also enables previously completed plans that share some but not all characteristics with a new crisis situation to be modified

considering those differences. This feature allows the planning process for a new crisis to be accelerated by adapting a pre-existing plan to the new situation.

TUTORIAL

The Tutorial for the DSSCO toolset provides instruction on CAP (emphasizing the planning products created by CINC-level planners) and the many features and capabilities of the toolset. New users can learn the basics of CAP and toolset use, while experienced planners can learn about the more advanced features of the toolset such as the resource links, information blocks, TaskSelector, and TVM. The self-paced Tutorial is organized into sections that can be accessed according to the user's interests.

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USER COMMENTS

All components of the toolset underwent extensive testing and evaluation throughout the DSSCO project. The aim was to determine whether each component was functioning as intended in its individual operation and in its interactions with other toolset components. Two major considerations were the informational content of the toolset and the interface design of each tool. Human factors engineers and software developers at Pacific Science & Engineering Group, Inc. and SPAWAR Systems Center, San Diego (SSC San Diego) informally evaluated early versions of the DSSCO toolset. These evaluations were conducted to ensure that the toolset had the features and functionality needed as the toolset grew in complexity.

As toolset development became more involved, formal usability testing was conducted on successive builds of the toolset. The functionality and interface design of the toolset became better defined as the project progressed from its early stages. It was therefore appropriate to perform formal usability testing to identify potential problems before they became entrenched in the structure and function of the toolset. These usability tests furnished a comprehensive assessment of how well the toolset was satisfying design requirements and the relative ease of use of its components. For example, three types of usability tests were conducted on Build 2 of the toolset and reported in a separate document (Heacox, et al., 2001). Findings from these usability tests are discussed in the next section.

USABILITY TESTS OF BUILD 2 OF DSSCO TOOLSET

This section discusses the results of three usability assessments conducted on Build 2 of the DSSCO toolset. These assessments included a human factors heuristic evaluation of toolset interfaces and two usability evaluations that collected empirical data to assess the toolset's ease of learning and use (Heacox, Gwynne, and Quinn, 2000). Two major components of the toolset were evaluated, the Planning Tool and TVM. Valuable information was received about how to improve the informational content and interface design of both tools. Future builds of the DSSCO toolset incorporated recommendations based on the results of these usability tests to bring the toolset closer to the functional level required for its anticipated role at PACOM.

Major Findings

The results of the heuristic evaluation and the empirical studies indicated that the DSSCO toolset could be improved by refining its interfaces and adding information to its databases. For interface improvements, recommendations were made for enhancing user controls such as buttons. These enhancements help planners navigate from one area of a tool to another and from one tool to another, increasing the legibility of text and limiting display colors.

As part of the heuristic evaluation, toolset interfaces were evaluated for the extent to which they complied with DII COE specifications. DII COE compliance is desirable because the toolset will be used with other applications that comply with DII COE standards. For the toolset to be easily integrated with these other applications, it should present users with the same interface conventions for information presentation and manipulation, window design and management, navigation, menus, and controls. In general, the toolset complied with DII COE user interface specifications. However, several areas were identified as non-compliant; future builds of the toolset will rectify these shortcomings and move the toolset toward greater DII COE compliance.

Several new interface features were recommended for future builds of the toolset. These features included enhanced alerts to changing circumstances and updated information, and comparing various COAs as mission requirements. Other features included creating a more thorough training protocol for new users; providing context-sensitive online help; enabling toolset databases to be expanded, updated, and linked to other information sources; and developing a work management system that allows enhanced access to links and reports.

For informational content, more information was desired in several distinct areas: coalition partners' capabilities and availabilities; conditions, such as geographic and demographic factors, that could influence plan formulation; recent events in a given country that could affect the planned mission; and current location and home base of each coalition contingent. Enhanced user logs were desired to validate the information in a database and to track more closely the changes made to database entries, when and by whom.

Collaboration was cited as a capability that should be developed further and incorporated in future builds. In the Operations Planning Team environment, some planner may be collocated while others are geographically separated. Geographically separated users must collaborate with each other to perform their tasks. A task analysis that identifies the information requirements of various users would facilitate the development of collaborative tools. A task analysis would also help improve information displays and interaction modes for all users.

Many recommendations arising from these usability tests will be incorporated in future builds of the toolset. These builds will continue to be evaluated at PACOM for their ability to facilitate multi-national coalition mission planning and execution. Longer term goals also will be increasingly considered as the toolset attains more mature development. These goals include integrating the toolset with other applications used by coalition planners to form and execute coalition operations.

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RECOMMENDATIONS FOR FURTHER DEVELOPMENT

Build 3 of the DSSCO toolset incorporates many improvements based on the test and evaluation of earlier toolset implementations. These improvements have made the toolset more powerful, versatile, and easy to use. However, ongoing usability testing and human factors evaluations indicate that further enhancement and refinement of the toolset are possible. This section discusses recommendations that will enable the toolset, once it is put in an operational setting, to increase its value to coalition mission planners.

- Coalition mission planning and execution are inherently collaborative activities. Therefore, an implemented version of the toolset must enable collaboration among its users. This implementation will require the development of a multiple workstation architecture to promote collaboration among planners who are geographically separated or who work at different times. To reach its greatest potential, the toolset must be integrated with other software applications such as the wide-ranging mission planning capabilities offered by the ACOA suite of tools.
- Operational personnel have indicated that “what-if” analyses would be valuable if results were quickly available. The CAESAR tool may provide planners with insights into consequences of alternate task constraints and performance levels. Its integration with the DSSCO toolset should be pursued.
- The concept of a “Conflict Catcher” that identifies potential cultural or organizational problems during the planning process and suggests interventions to address potential process “derailers” (O’Mara, 2000b; Smillie³) has been received well by operational personnel. A promising line of development of the Conflict Catcher is the expert critiquing system now used successfully in medicine (Heacox, 2001a). The Conflict Catcher could be linked to the resource databases, the planning objectives, and the planning products to summarize progress and risk assessments.
- TVM components provide visualization of tasks, resource assignments, schedules, and performance/scheduling dependencies. TVM could be expanded with a module for evaluating scheduling options and highlighting potential scheduling problems. Other expansions could include a module to evaluate the probability of success of individual tasks or “what-if” scenarios based on mission performance requirements and task dependencies and a monitor to collect real-time feedback during plan execution of the plan (Heacox, Moore, and Smillie, 2000).
- Using the toolset for training OPT members and other personnel who create and evaluate crisis action plans has been successfully piloted. With continued development of the Tutorial module of the toolset, training possibilities will be expanded. Given its comprehensive representation of CAP phases and activities, the toolset holds promise as a teaching aid for experienced and novice crisis action planners.

³ R. J. Smillie. 2000. “Conflict Catcher Example: ‘Restore Order’.” Memorandum (Nov). SSC San Diego, CA.

- Database maintenance and expansion should be made more integral aspects of the toolset to facilitate its reliability, ease of use, and adaptability to novel situations.
- Technologies should be investigated for their ability to add features and capabilities to the toolset, which could include more data push, knowledge mapping, data mining, and intelligent search and retrieval.

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APPENDIX A

DSSCO TOOLSET AND DII COE COMPLIANCE

The Defense Information Systems Agency (DISA) developed the Defense Information Infrastructure (DII) Common Operating Environment (COE) to facilitate software and database development by Government agencies and their contractors. DII strives to produce a highly integrated web of communications networks, hardware, software, databases, applications, and other capabilities that meet the information processing and transport needs of Department of Defense (DoD) users. The COE component of DII provides the common software infrastructure used by DII software, databases, and applications. DoD will rely on DII COE to provide the degree of system integration and interoperability needed to meet diverse operational requirements. Given the central role of DII COE in the evaluation of new software developed for DoD, the DSSCO toolset should conform closely to DII COE requirements.

DII COE originated with a simple observation about command and control systems. Some functions (e.g., mapping, track management, communication interfaces, etc.) are so fundamental that they are required for almost every command and control system. Yet these functions are often built over and over again in incompatible ways, even when the requirements are the same or vary only slightly between systems. If these common functions could be extracted, implemented as a set of building blocks, and made readily available to system designers, development times could be reduced and substantial savings could be achieved through software reuse. Interoperability would also be significantly improved if common software were used across systems for common functions.

LEVELS OF DII COE COMPLIANCE

Figure A-1 shows the eight levels of compliance established for DII COE. Level 5 is the mandated minimum level that must be met for a software or database component to be considered sufficiently DII-COE-compliant to be in a DII COE build library; Level 8 is the targeted compliance level. The basic characteristics of Levels 5 through 8 are as follows:

- **Level 5 Minimal.** All segmented applications share the same COE kernel. Functionality is available through the Executive Manager. Segments can be installed and uninstalled using COE installation tools. Segment interfaces adhere to the “look and feel” defined in *User Interface Specifications for the DII*. Segments are registered and are available through the online library. Data are stored separately from applications, categorized according to their potential for sharing, and can coexist on a COE data server with other segments.
- **Level 6 Intermediate.** Segment functions are at least 50 percent COE-implemented. Segments reuse one or more COE-component segments. Substantial security requirements are imposed upon segments. Minor documented differences may exist between the segment’s interface and the criteria in *User Interface Specifications for the DII*, including required data model, database schema, business rules, valid values, element definitions, etc.

- **Level 7 Interoperable.** Segments reuse COE-component segments to ensure interoperability. Segments do not duplicate any functionality with the COE component segments. No more than 25 percent of the data can be duplicate with COE or the COE-based target system. The software uses at least 75 percent public APIs for COE service access. Use of any private APIs must be documented. Data associated with a database segment are consistent within the defined and registered Community of Interest.
- **Level 8 Full:** COE or co-hosted segments have no duplication of functions. Segments are available through the Executive Manager, are 100 percent compliant with *Integration & Runtime Specification* and *User Interface Specifications for the DII*, and use only published public APIs. Data associated with a database segment are coordinated with the Defense Data Model and do not overlap with any extant COE component database segments.

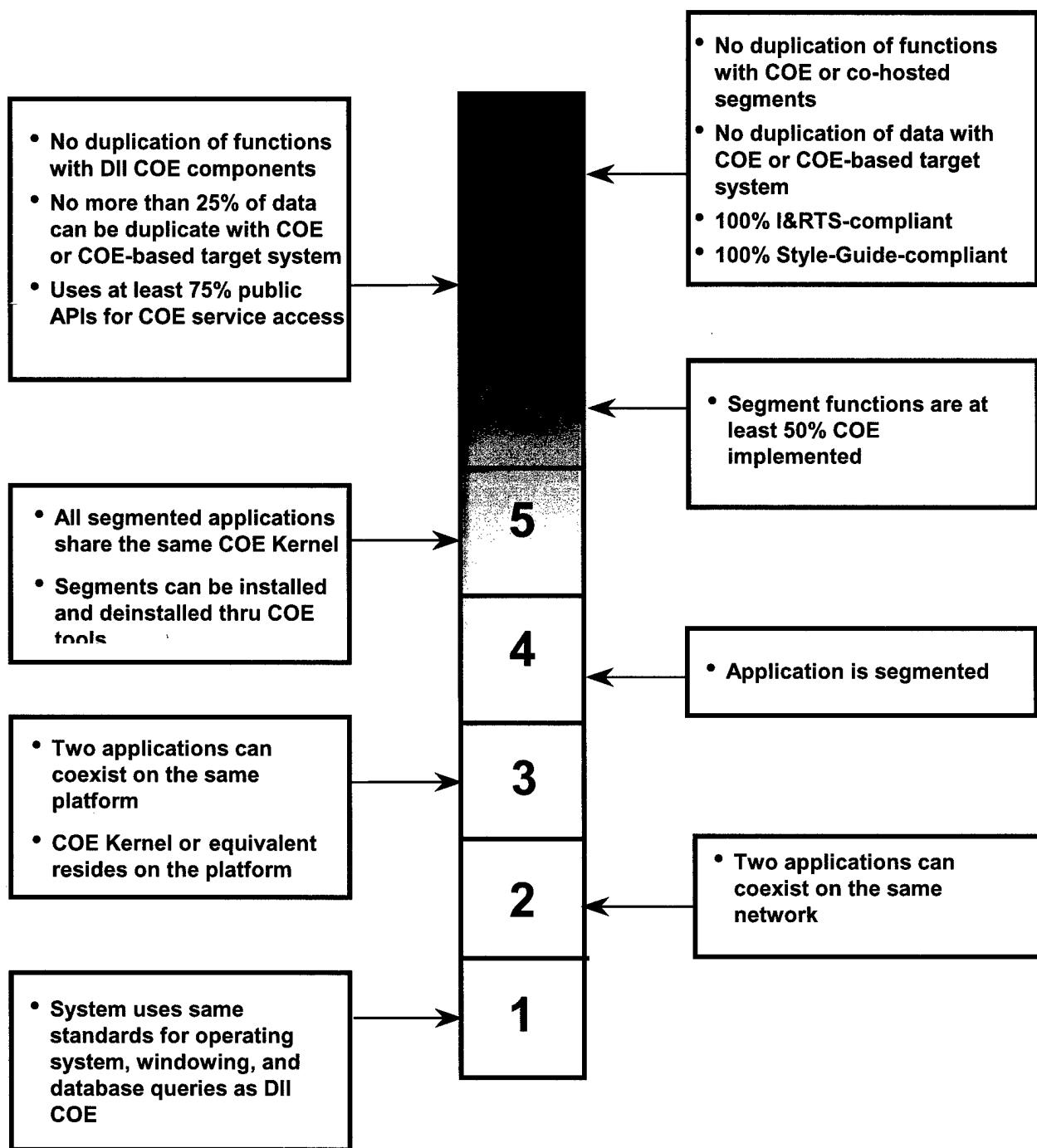


Figure A-1. Eight levels of DII COE runtime compliance (from K. Wheeler briefing, http://diicoe.disa.mil/coe/brief/DII_Conf_upd427.ppt).

DSSCO TOOLSET COMPLIANCE

The preceding discussion establishes that for software to be DII-COE-compliant, it must satisfy requirements and specifications in several areas: integration and runtime specifications, segmentation, user interface, documentation, and software and documentation delivery requirements.

The DSSCO project team has reviewed the DII COE documentation relating to the DSSCO toolset. In the team's opinion, the DSSCO toolset (Build 3) is Level 5 DII-COE-compliant for its various user interface aspects, including color, functionality, and action commands. Likewise, the documentation supplied with the toolset, online and hard copy, also meet Level 5 compliance requirements. Efforts will be made to ensure that new features and functionalities of the toolset are DII-COE-compliant to at least Level 5. As the toolset undergoes further development and refinement, an ongoing goal will be to make it DII-COE-compliant at successively higher levels.

APPENDIX B

ACRONYM GLOSSARY

ACOA	Adaptive Course of Action
C4	Command, Control, Communications and Computers
CAP	Crisis Action Planning
CARE	Cooperative for Assistance and Relief Everywhere, Inc.
CAS	Crisis Action Sequence
CCTF	Commander, Combined Task Force
C-day	Unnamed Commencement Date
CDR's EST	Commander's Estimate
CEASAR	Computer-Aided Evaluation of System Architecture
CINC	Commander-in-Chief
CJCS	Commander, Joint Chiefs of Staff
COA	Course of Action
D-day	Date of Commencement
DSSCO	Decision Support System for Coalition Operations
JCS	Joint Chiefs of Staff
JOPES	U.S. Joint Operation Planning and Execution System
NCA	National Command Authority
NGO	Non-Governmental Organization
OP ORD	Operation Order
OPT	Operations Planning Team
POC	Point of Contact
PVO	Private Volunteer Organization
TPFDD	Time-Phased Force and Deployment Data
TVM	Task Visualization Module (component of DSSCO)
UJTL	Universal Joint Task List

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